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THESIS

A STUDY OF THE VARIATIONS IN TYPE AND FREQUENCY OF WRITTEN PROBLEMS IN ONE UNKNOWN; AS EVIDENCED BY AN ANALYSIS OF SEVERAL STANDARD ALGEBRA TEXTBOOKS

submitted by

Theron Barker Thompson
(B.C.E., Northeastern, 1931)

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degree of Master of Education

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First Reader: G. M. Wilson, Professor of Education
Second Reader: Herbert Blair, Professor of Education

Boston University
School of Education

PREFACE

There is a three-fold purpose in writing a thesis of this type. First, it is written in partial fulfillment of the requirements for the degree of Master of Education.

Second, it should be of interest to every teacher of secondary school algebra, particularly those who have been using out-of-date textbooks and having difficulty with pupils who seem unable to grasp the necessary concepts of problem solving.

Third, it is an investigation to discover (1) how closely the authors of algebra textbooks follow the trend of the times in framing their problems, and (2) what changes have been made in the form and subject matter during the last hundred or more years that American Texts in Algebra have been published.

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Introduction

Most pupils in secondary schools find difficulty in solving the written problems of algebra. They may be able to grasp the details of addition, subtraction, multiplication, and division with comparative ease. After these fundamental processes are mastered they are introduced to the subject of linear equations. For the most part pupils find little difficulty in solving the literal equations which are presented by the score in most books.

Following the work on linear equations in one unknown is a section of written problems to be solved by utilizing the principles of the literal equations. It is this section which presents a great deal of difficulty to the pupils. The reasons for this trouble can be attributed to several factors. The foremost thought of a parent whose child does not understand the solving of these problems is that the teacher is not taking sufficient interest in the progress of the pupils to explain fully the methods involved.

The teacher will complain that the pupil does not follow her directions carefully, or, if it be a teacher of long experience, that the problems themselves are the cause. The latter reason is quite likely to be one of the causes, particularly if the textbook is very old. Some of the problems are even difficult for the teacher, unless she has the solutions and answers before her.

There is some conjecture as to the real reason why authors of the last century persisted in wording their problems as they did. Possibly it was because they had been taught that a certain amount of formal discipline could be attained at the same time that the pupil

was learning algebra. It may have been that the pupils and writers merely followed the trend of their times and copied the cumbersome language of writers on other subjects. Whatever the reason, the wording was copied by each succeeding generation of authors. Thus we arrive at the present with a load of tradition in written problems in algebra. Some simplification has taken place; more is needed. The thesis gives a fair picture of the progress toward simplification in written problems in one unknown.

I. Method of Procedure

In order to make any definite conclusions as to the changes in type or frequency of written problems it was necessary to make a thorough analysis of a series of standard textbooks which covered a period of years.

The first American algebras appeared about 1825. Before that time English editions, if algebra was studied at all, were in vogue. The most common of these English textbooks was one written by John Bonnycastle, called "An Introduction to Algebra," and published in London in 1808. This was a small, paper-bound volume, printed in heavy type on very coarse paper. There were no written problems immediately following the work on linear equations, but in the back of the book there were several pages of problems. Only three of these were solvable by equations in one unknown.

These problems, which are given below, are fairly easy to understand and solve, and have been found in similar form in later textbooks.

1. A person being asked what o'clock it was, answered, that it was between 8 and 9, and that the hour and minutes hands were exactly together; what was the time? ans. 8:43:38 2/11

2. Divide the number 50 into two such parts, that $\frac{3}{4}$ of one part, added to 5/6 of the other, may make 40. ans. 20 and 30.

3. What two numbers are those, whose difference is 12, and their squares equal to each other? ans. -6, +6.

The answers in each case were printed with the problem as shown.

The next book analyzed was, "Elements of Algebra," by Jere-

miah Day and James B. Thompson. This Book was originally written between 1840 and 1842; the particular edition used in this study being dated 1854. As shown by the summary (p. 28) this book contains 50 problems which are massed together with no particular system of classification.

To facilitate the classification of these problems they have been arranged in the following types; Age, Cost, Distribution, Geometry, Investment, Mixture, Money, Numbers, Percentage, Uniform Motion, Value, Work, and a small group of miscellaneous problems which seemed to deal with none of the other types. To avoid repetition in grouping the problems of the different books, each problem has been reduced to its simplest equational form and then the numerical values have been exchanged for literal values as will be explained later. This makes for a smaller number of equations in the final form. Not all types are to be found in any one textbook, some authors stressing one type and others another, as is also shown in the summary.

The third book to be studied was,"A Practical Treatise on Algebra," by Benjamin Greenleaf, written in 1852, and later improved and reprinted in 1867. Benjamin Greenleaf was an authority on mathematical subjects during the middle part of the 19th century, and any of his works may be taken as standards of that time. Greenleaf included 60 problems in his book. They are in the same miscellaneous grouping as the previous book, but the first twelve, which are fairly representive of the group, are solved in full by the author, thereby giving some enlightment as to the method of solving the others. The answers are also included with each problem; two of which are listed below to show the wording used by Greenleaf.

1. A spendthrift spent 1/5 of the fortune left him by his father, and then he earned $124. Soon after he lost by speculation 2/3 of his property, after which he gained $274. His property was now valued at 1/2, wanting $86, of his original estate. What was the sum left him by his father? ans. $1720.

2. A certain clock has an hour hand, a minute hand, and a second hand, all turning on the same centre. At 12 o'clock all the hands are together and point at 12. How long will it be before the second hand will be between the other two hands, and at equal distances from each? Also, before the minute hand will be equally distant between the other two hands? Also, before the hour hand will be equally distant between the other two hands?

ans. $60\frac{780}{1427}$ seconds, $61\frac{683}{697}$ seconds, $59\frac{13}{73}$ seconds.

As can be seen from the answers of the last problem the student also received some practice in fractions if he suceeded in solving the problems.

The remaining books in the list of those analyzed are of the twentieth century down to the present time, and include:

"Elementary Algebra," G. A. Wentworth, 1906.

"First Year in Algebra," W. J. Milne and W. F. Downey, 1911-1924.

"Second Course in Algebra," same authors, 1911-1925.

"Second Course in Algebra," Fred Engelhardt and L. D. Haertter, 1929.

"Algebra," W. R. Longley and H. B. Marsh, 1929.

"Modern Second Course in Algebra," W. Wells and W. W. Hart, 1929.

1. A spendthrift spent 1/3 of the fortune left him by his father, and then he earned $[illegible]. Soon after he lost by speculation 2/3 of his property, after which he gained $[illegible]. His property was now valued at 1/3, wanting $[illegible], of his original estate. What was the sum left him by his father? Ans. $1750.

2. A certain clock has an hour hand, a minute hand, and a second hand, all turning on the same centre. At 12 o'clock all the hands are together and point at 12. How long will it be before the second hand will be between the other two hands, and at equal distances from each? Also, before the minute hand will be equally distant between the other two hands? Also, before the hour hand will be equally distant between the other two hands?

Ans. [illegible] seconds, [illegible] seconds, [illegible] seconds.

As can be seen from the answers of the last problem the student also required some practice in fractions if he succeeded in solving the problem.

The remaining books in the list of texts analyzed are of the twentieth century down to the present time, and include:

"Elementary Algebra," G. A. Wentworth, 1906.

"First Year in Algebra," [illegible], 1911-1926.

"Second Course in Algebra," same authors, 1911-1925.

"General Course in Algebra," [illegible] and [illegible], 1923.

"Algebra," [illegible] and [illegible], 1929.

"Modern School Course in Algebra," [illegible] and [illegible], 1923.

Each book has been carefully analyzed as to the number, type, and subject of written problems in one unknown, and the results tabulated, as shown in the tables.

II. Explanation of the Tables.

The thirteen tables which follow are a tabulation of the problems analyzed. Each table represents one type of problem, as Age, Cost, etc.

The method of classification, which has been explained briefly elsewhere, was to reduce each problem to its simplest equational form and then to substitute literal values for the numerical values.

A few illustrations should make this clear.

1. A gentleman lived single $\frac{1}{4}$ of his whole life; and after having been married 5 years more than $\frac{1}{7}$ of his life, he had a son who died 4 years before him, and who reached only $\frac{1}{2}$ the age of his father. To what age did the father live?*

Letting x = the number of years the father lived.

then $\frac{x}{4}$ = " " " " " " single (lived).

and $\frac{x}{7} + 5$ = " " " " " " was married before the son's birth.

also $\frac{x}{2}$ = " " " " " boy lived.

and $\frac{x}{2} + 4$ = " " " " after the boy was born that the father died.

$\therefore \frac{x}{4} + \frac{x}{7} + 5 + \frac{x}{2} + 4$ = the number of years that the father lived.

But x = " " " " " " " "

$$\therefore \frac{x}{4} + \frac{x}{7} + 5 + \frac{x}{2} + 4 = x$$

By substituting literal values for the numerical values we get,

$$\frac{x}{a} + \frac{x}{b} + A + \frac{x}{c} + B = x$$

From this equation it may be seen that the small letters have been used to represent fractions, and capital letters for whole numbers.

2. A dealer bought 25 dozen oranges for $9.25. For a part he paid 40 cents a dozen, and for the remainder 35 cents a

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*See table I. Ages problem 3.

dozen. How many dozen did he buy at each price?*

Let x = the number of dozens at 40 cents.

and 25 - x = '' '' '' '' '' 35 ''

then x($.40) = '' '' '' cents those dozens at 40 cents would cost.

and (25-x)($.35) = '' '' '' '' those dozens at 35 cents would cost.

and x($.40) + (25-x)($.35) = the total cost of both.

but $9.25 = '' '' ''

$$\therefore x(\$.40) + (25-x)(\$.35) = \$9.25.$$

again substituting in literal values we get,

$$x(A\cancel{c}) + (B-x)(C\cancel{c}) = \$D.$$

This same form of equation is also found in the distribution and mixture types.

3. The sum of two numbers is 74. If the larger is divided by the smaller, the quotient is 7 and the remainder is 2. Find the numbers.**

If we let x = one number,

and 74-x = the other number.

$\frac{74-x}{x}$ = will be one divided by the other.

but one divided by the other should equal 7 and a remainder of 2.

$$\therefore \frac{74-x}{x} = 7 + \frac{2}{x} \text{ or,}$$

$$\frac{74-x}{x} = \frac{7x+2}{x}$$, which changed to literal values gives

$$\frac{C-x}{x} = \frac{ax+B}{x}$$

4. A man has 12 hours for an excursion. How far into the country can he ride a bicycle at the rate of 15 miles an hour so as to return in time, driving a horse at the rate

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*See table II. Costs problem 6.

**See table VIII. Numbers. problem 46.

of 5 miles an hour?*

let x = the number of hours he goes by bicycle.

and $12-x$ = '' '' '' '' '' '' '' horse.

then $15x$ = '' '' '' miles '' '' '' bicycle.

and $5(12-x)$ = '' '' '' '' '' '' '' horse.

and then, as he returns to his starting point,

$15x = 5(12-x)$, which reduced to a literal equation reads,

$$ax = b(A-x).$$

5. A gentleman bought a chaise, horse, and harness for 360 dollars. The horse cost twice as much as the harness; and the chaise cost twice as much as the harness and horse together. What was the price of each?**

If we let x = the number of dollars the harness cost,

then $2x$ = '' '' '' '' '' horse ''

and $2(x+2x)$ = '' '' '' '' '' chaise ''

and $x + 2x + 2(x+2x)$ = '' '' '' '' all three cost.

but \$360 = '' '' '' '' '' '' ''

$$\therefore x + 2x + 2(x+2x) = \$360.$$

reduced to a literal expression,

$$x+ax+b(x+ax) = \$C.$$

6. John can do a job in 4 days. Bill can do the same job in 5 days. If both work together how long will it take them to do the job?***

Let x = the number of days it will take John and Bill together.

then $\frac{1}{x}$ = '' part they can do in one day.

now, $\frac{1}{4}$ = '' '' John can do in one day

---

*See table X. Uniform Motion. problem 5.
**See table XI. Value. problem 5.
***See table XLL. Work. problem 6.

and $\frac{1}{5}$ = the part Bill can do in one day.

$\therefore \frac{1}{4} + \frac{1}{5} =$ " " they can both do in one day.

$$\therefore \frac{1}{4} + \frac{1}{5} = \frac{1}{x}$$

If this is substituted with literal values we get,

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{x}$$

With this explanation the reader should have little difficulty in understanding the tables. The numbers in each column refer to the page and problem number of the book at the head of the column.

The description immediately following the literal equation is only a brief resume of the originals. For a complete statement of each problem the reader is referred to the appendix.

For example, referring to Table I, p. 16, we have a classification of the Age problems in One Unknown in the nine texts used as a basis for this study. The table is read as follows:

Problem #1 is found in Greenleaf's Algebra, page 78, prob.1. It can be found also in Wentworth's Algebra as prob. 14, page 28. This problem has to do with finding the ages of a father and his son when the ages of both together are given, and the father's is found to be a certain number of times greater than the son's.

Problem #2 is found in Day and Thompson's Algebra, page 89, prob. 36, and in Greenleaf's Algebra, prob. 14, page 83. In this problem the ages of three persons are involved. The first is "A" times as old as the second, and the third is "B" times as old as the second. The sum of their ages is some number. Find the ages. Etc.

Table I. Ages

Table I. Analysis of Algebra Problems in One Unknown — 9 texts – Ages

	Problems dealing with AGES	An Introduction to ALGEBRA John Bonnycastle 1808	Elements of ALGEBRA Jeremiah Day James B. Thompson 1854	A Practical Treatise On ALGEBRA B. Greenleaf 1867	Elementary ALGEBRA G.A. Wentworth 1906	1st Year ALGEBRA W. J. Milne W. F. Downey 1911-1924	2nd Course in ALGEBRA W. J. Milne W. F. Downey 1911-1925	2nd Course in ALGEBRA Fred Engelhardt L. D. Haertter 1929	ALGEBRA W. R. Longley H. B. Marsh 1925-1929	Modern 2nd Course in ALGEBRA W. Wells & W. W. HART 1929	Totals
1	$x+ax=A$ Father "a" Times as old as Son – both = A years ※			78-1	28-14						2
2	$x+ax+bax=C$ Man "a" Times as old as Wife, who is "b" Times as old as daught. 3 Together = C years		89-36	83-14							2
3	$\frac{x}{a}+(\frac{x}{a}+A)+\frac{x}{c}+B=x$ (see page 12 illustration #1		88-26								1
4	$x+ax=C-A$ Father is A years more Than "a" Times Son's Age. Together = C years				31-46			46-6			2
5	$ax-A=b(x-A)$ " " "a" Times as old as Son. "A" years ago he,				28-21, 32-57		102-20	46-14	129-10		5
6	$(x+A)-B=a(x-B)$ One is "A" years older, "B" years ago [was "b" Times as old]							47-15	129-13		2
7	$x+A=\frac{a}{b}(x+A+B)$ Similar						102-18				1
8	$\frac{a}{b}(x-A)=\frac{x}{c}-A$ Son $\frac{1}{2}$ as old as father; "a" years ago he was $\frac{1}{3}$ as old						102-19				1
9	$x-A=a(C-x-A)$ Sum of 2 ages = C; "A" years ago 1 was Twice as old								129-11		1
10	$A-x=a(B-x)$ Man is "A" years, Son "B"; when was Man's 3 Times son's								134-2		1
11	$ax+A=b(x+A)$ " " "a" Times Son, in "A" years he will be "b" Times				29-22, 30-33				129-9, 12, 14		5
12	$ax\pm A=b(x\pm A)\pm B$ One is "a" Times ± "A" years as other, in "B" years will be " "				30-34				129-15, 130-16		3
13	$\frac{x}{a}+\frac{x}{b}+C=x$ Man spent "$\frac{1}{a}$" of life in 1 country, "$\frac{1}{b}$" of life in another country, "C" years in 3rd country.		87-19								1
14	$x+A=ax$ 6 sons; 4 years between each; oldest is 3 Times as old as youngest.		90-42								1
14	Totals	0	4	2	7	0	3	3	9	0	28

※ For a complete quotation of each problem see Appendix

Table II. Analysis of Algebra Problems in One Unknown - 9 texts - Cost

	Problems of COST	Bonny-Castle 1808	Day & Thompson 1854	Green-leaf 1867	Went-Worth 1906	Milne-Downey 1	Milne-Downey 2	Engelhardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1	$ax+A-B=C$ Price of watch; Multiplied and increased & decreased by numbers		83-1								1
2	$a\left(\frac{c-x}{b}\right)=x$ Price of Molasses pump and tubing. tubing by foot.					191-5					1
3	$ax+A=x+B(\%)x$ Cost of beef if gain was certain percent.					195-40					1
4	$x+ax+bx=\overset{\$}{D}$ Ann Paid \$3.00 for 3 books. 1st Cost $\frac{1}{2}$ as much as 2nd and $\frac{1}{3}$ as much as 3rd						105-40				1
5.	$x+A=ax$ 1 Paper costs $\frac{1}{3}$ as much as 2nd. 1st costs \$50 less per ton. find cost/Ton of ea.						105-41				1
6.	$x(A\text{¢})+(B-x)(C\text{¢})=\overset{\$}{D}$ (See page 12 illust. #2) also #books, bbl's flour, boxes of Candles.				29-23	192-11 192-12	105-42				4
7	$\frac{ax}{b}=x-(A\text{¢})$ Cost/mile for operating Train was $(\overset{\$}{.14})$ less by Electricity than Steam, or $\frac{3}{5}$ as Much.						105-43				1
8	$ax(A)+x(B)=\overset{\$}{D}$ Cost of Coal and wood. Coal per Ton costs "a" Times wood per cord.				29-27						1
9	$\overset{\$}{a}x=b(\overset{\$}{x}-1)$ Cost of sheep. he could have had more for less price per sheep				31-47						1
10.	$\overset{\$}{A}+\overset{\$}{B}x=\overset{\$}{D}+(C-x)\overset{\$}{E}$ Cost of coal/Ton is different at 2 points; Hauling rates are diff. from each point. Find point where Prices will be equal.								136-21		1
11	$a(x+A)-bx=C$ Cost per mile to run 2 autos certain distances					193-22					1
11	Totals	0	1	0	3	5	4	0	1	0	14

Table III Distribution

Table III. Analysis of Algebra Problems in One Unknown – 9 Texts. – Distribution

	Problems having to do with DISTRIBUTION	Bonny Castle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne Downey 1st	Milne Downey 2nd	Engelhardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1.	$A-x=x+B$ Boy has 2 Kinds of coins, more of one than of other							46-12			1
2.	$x(A¢)+(C-x)(B¢)=\$D$ # of Coins of 2 Kinds if sum = $D				30-39			76-16, 77-27	136-18		4
3.	$x(A¢)+x(B¢)=\$D$ Similar								131-21, 134-1		2
4.	$x(A¢)+(x+B)(C¢)=\$D$ Similar								130-18		1
5.	$x(A¢)+ax(B¢)=\$D$ Similar				29-34 31-48 30-40 32-54				130-17		5
6.	$x(A¢)+ax(B¢)+bax(C¢)=\$D$ Same but 3 coins of				32-63				130-19 131-20 135-16		4
7.	$x(A¢)+ax(B¢)+(x+ax)(C¢)=\$D$ different values which added						102-13				1
8.	$x(A¢)+ax(B¢)+(ax+N)(C¢)=\$D$ Together give $D.								131-22		1
9.	$\frac{x}{C-x}=\frac{a}{b}$ Prize divided in 2 parts; to each other as $\frac{a}{b}$		87-16								1
10.	$x+\frac{ax}{b}=C$ Same			84-21							1
11.	$x+(x+A)=C$ Prize to 2 so that one gets more			80-7							1
12.	$x+(x+A)+(x+A+B)=C$ Money to 3 so that each gets part.			84-20							1
13.	$x+ax+bx=C$ Money to 3 so that 2 get "a" ("b") Times as Much.			80-6	28-18						2
14.	$x+(x+A)+(x+x+A)=C$ Estate to 3; Oldest gets as much as others.			86-40							1
15.	$\frac{x}{a}-A+\frac{x}{b}-B+\frac{x}{d}-D=x$ " " 3; each gets Fraction of whole		84-3								1
16.	$(\frac{x}{a}-A)+(\frac{x}{b}+B)+C=x$ Purse to 3; " " " " "			86-41							1
17.	$x+ax+b(x+ax)=\$C$ 3 Men in Co., get part of gain made			84-27							1
18.	$(A+\frac{x}{a})+(B+\frac{x}{b})+(C+\frac{x}{c})+(D+\frac{x}{d})=x$ Estate in parts to 4 Sons		86-9								1
19.	$x+(x+A)+(x+A+B)+(ax+C)=D$ Estate to 4, All different Sums			80-5							1
20.	$x+(ax)+(x+ax)+[ax+(x+ax)]=C$ Money to 4 beggars so that 1st has 2 Times as much as 2nd; 3rd has 1st + 2nd, etc.			83-15							1
21	$ax+\frac{bx}{d}+bx=\$C$ Estate to wife and family of 3 sons, 2 daughters			83-17							1
22	$A+(A+\frac{x}{a})=x$ Amount of Prize that 3rd Mans gets		87-12								1
23	$x+x+A+x+B+x+C=ax+D$ Shillings to 4 Sons		89-33								1
24	$x+ax+(x+ax)=\$C$ 3 Men buying a farm.				28-19						1
25	$x+ax+(x+ax)+(x+ax+ax)=\$C$ 4 Men buying a farm		89-31								1
26	$ax=b(x+A)$ 10 buy camp, but 2 drop out; Find shares of 8.				29-29						1
27	$\$Ax+\$B(ax)=\$C$ Number of cows and oxen at 2 prices			83-16							1
28	$\$Ax+\$B(ax)+\$D(bax)=\$C$ Number of Apples, Oranges, pears a boy can buy for a Sum, if each has different Cost.			83-16							1
29	$\frac{ax}{b}+\frac{x}{c}+\frac{x}{d}+A=x$ Fractions of the Sum of Trees are Pear, Apple, etc.		88-23								1
30	$\frac{x}{a}\$A+\frac{x}{a}\$B=\$C$ Half of wood is sold for 1 Price, ½ for 2nd price				28-13						1
31	$ax+bx=C$ Tons of coal on barge + schooner						102-17				1
32	$a(x+A)=bx+A$ # Plums to 2 boys, if each had few more.						102-14				1
33	$x+\frac{x}{a}=C$ # logs on 4 Wagons, 1 holds more than others						102-15				1
34	$ax+A=C$ # eggs in pails + baskets						102-16				1
35	$\frac{A}{\frac{a}{b}(x-B)}=\frac{c}{x}$ # Gallons of wine after part is used		88-24								1
36	$\frac{x}{a}\$A+\frac{x}{b}\$B+\frac{x}{c}\$C+\frac{x}{d}\$D=\$K$ Parts of a sum of Tennis Racketts are sold at different prices					192-13					1
37	$x+(x+A)+(x+A+B)=C$ Certain # of days are Clear, Cloudy, Partly Cloudy					192-16					1
38	$x-A=\frac{a}{b}(C-x+A)$ $C-x-A=\frac{d}{m}(x+A)$ 2 Boys have C Apples. if 1 gives the other part of his he will fraction of what other has			84-28							1
39	$\frac{ax}{b}+\frac{a}{c}(x-\frac{ax}{b})+K+\frac{a}{cd}(x-\frac{ax}{b})=x$ Part of pupils in room read, Part write, etc. Find Total # in room.			85-36							1
40	$\frac{x}{a}+A+\frac{b}{c}(x-(\frac{x}{a}+A)]-B+C=x$ Merchant sells part of Flour			86-45							1
41	$\frac{x}{a}+A+\frac{x}{b}+B+\frac{x}{c}+C=x$ Parts of Army Killed, or wounded		91-50								1
42	$x^2+A=(x+B)^2-C$ Company of men Need "A" men to form Square								136-19		1
43	$\$Ax+\frac{\$B(C-x)}{a}=\$D$ # Cakes of Soap Sold at 2 prices.					193-21					1
44	$x=\frac{a(x+x+A)}{b}$ # Bushels of wheat and Straw in grain.					193-20					1
45	$x-A=a(x-B)$ # Sheep in 2 Flocks after part are sold.		89-34								1
46	$\frac{x}{a}-A=\frac{b}{d}(C-x)-B$ Total runs scored by 2 Baseball Teams.					191-2					1
47	$ax-A=b(C-x)-B$ # Fish caught by Boy and Father					191-1					1
48	$\frac{a}{b}(x+A)=Cx$ # Shots fired by Boat. Hits and Misses					191-8					1
49	$ax+bax=C$ # of 2 Kinds of Light bulbs in hall.					191-6					1
50	$x+x+A=B$ # Votes cast for 2 candidates.				31-52						1
50	Totals	0	10	15	11	8	5	3	10	0	62

Table IV. Geometry

Table IV. Analysis of Algebra Problems in One Unknown – 9 texts – Geometry

	Problems Involving Geometry	Bonnycastle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne Downey 1	Milne Downey 2	Engelhardt Haertter 1929	Langley Marsh 1929	Wells Hart 1929	Totals
1	$A=\frac{1}{2}bh$ Area of Triangle and base – find height							74-8			1
2	$ax+x+\frac{bx}{c}=180^\circ$ 1st ∠ of △ is twice 2nd, 3rd = $\frac{3}{5}$ of 2nd							77-21			1
3	$x+x+ax=180^\circ$ 1st ∠ of △ is = 2nd, 3rd is 3 Times 1st							73-2			1
4	$x=a(90-x)$ ∠ equals "a" Times its complement.							74-3			1
5.	$x=\frac{a}{b}(180-x)$ " " $\frac{1}{5}$ of its supplement							74-4			1
6.	$(n-2)180=A$ Sum of int. ∠s of polygon = A°, Find # of Sides							74-5			1
7	$ax=C$ given Area and width of Flowerbed, find Length							73-1			1
8	$x+A=a(x-B)$ Dimensions of Playground					191-9					1
9	$A=bx-B$ Length of {Bridge / Boat} is A ft., or B ft. less than "b" Times its length						104-37, 39				2
10	$ax-B=bx$ " " Tunnel is "a" Times width, If Len. was B ft. less it would be "b" Times width						104-38				1
11	$W_1 \cdot L_1 \cdot x=W_2 \cdot L_2 \cdot T_2$ Thickness of plate to be rolled from another Plate							74-7			1
12	$P=2(a+b)$ Perimeter of {desk / field / Tennis court} given, Length is ratio of width $W=x$						104-34	74-9 75-1			3
13	$(w+A-B)(w+c)+D=w(w+A)$ Dimensions of Room. if Length is changed							74-10	135-12, 13		3
14	$x(x+A)=(x+B)(x+B)$ Dimensions of a rectangle which has same area as Square						104-35				1
15	$(x+A)(ax\pm B)=(x\cdot ax)\pm C$ Dimensions of field by {increasing / decreasing} {Length / width}						104-36		135-9, 10, 11		4
16	$C=[2H(L+w)+(L\cdot w)-A]\,\#B$ Cost of painting ceilings and walls of room – Window area to be taken out							74-6			1
17	$x+ax=C$ Length of {Tree / Pole} if top falls over				28-15 30-38 32-58						3
18	$ax+A=x+B$ Well is deepened certain distance					195-39					1
19	$\frac{x}{a}+\frac{dx}{b}+C=x$ Sections of Post in water, Mud, & Air		87-21								1
20	$a(x-A)=bx-A$ # Gallons in 2 casks of different size.		90-45								1
21	$\frac{x}{a}+A=\frac{x}{b}$ Part of wine has leaked from Cask, "A" gall. are drawn, + Cask is $\frac{1}{2}$ full		90-41	84-24							2
22	$\frac{ax}{b}+x+\frac{cx}{d}=K$ distances between 4 points. distances vary in ratio's, etc.		91-47								1
22	Totals	0	4	1	3	2	6	12	5	0	33

Table V. Analysis of Algebra Problems in One Unknown - 9 texts - Investment

	Problems of INVESTMENT	Bonnycastle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne Downey 1	Milne Downey 2	Engelhardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1	$(x+\%x)+\%(x+\%x)+\%[(x+\%x)+\%(x+\%x)]-A=C$ Sum of money lent for 3 years			85-37							1
2	$(A\%)x+(B\%)(x+M)+(C\%)(x+N)=K$ Sum at 3 rates									57-2	1
3	$\frac{ax}{b}(A\%)+\frac{dx}{b}(B\%)=C$ Sum at 2 rates			87-52		192-10	105-48				3
4	$(A\%)x\pm(B\%)(C-x)=A$ same					194-33 195-34	105-44,45 106-49,50	77-22			7
5	$(A\%)x=a(B\%)(C-x)$ Same						106-51	78-32			2
6	$(A\%)\frac{ax}{b}+(B\%)\frac{x}{c}+(C\%)\frac{x}{d}=\$D$ Sum at 3 rates						106-53				1
7	$(A\%)x+(B\%)(D-x)=(C\%)\$D$ Sum at 2 rates = 3rd						105-47 106-52			57-4,5	4
8	$x+ax(A\%)=C$ Principle to = sum.			88-54							1
9	$\$A\cdot a(B\%)=\$C\cdot x(D\%)$ Time for 1st sum to = 2nd			88-55							1
10	$\frac{An}{a}(\%)=x$ Income on Investment					195-41					1
11	$(A\%)x+A=\frac{b}{c}x(B\%)$ 2 loaning at diff. rates					195-35					1
12	$x+(A\%)x=\$B$ Capital received by 2 men						105-46				1
13	$(A\%)[x-(B\%x)]=\$C$ Profit for 1 year						106-54				1
14	$\frac{\$A+\$x}{2}=\$B$ Average Profit for 2 years						106-55				1
15	$(x-A)+\frac{a}{b}(x+A)-A=d[(x+A)-\frac{M}{b}(x+40)]$ Investment of 2 men		90-38								1
16	$\$A(B\%)+\$C(D\%)+\$x(E\%)=(A+C+x)(F\%)$ Amount to Invest to get Income									57-1,3,6	3
16	Totals	0	1	4	0	5	12	2	0	6	30

Table VI. Analysis of Algebra Problems in One Unknown — 9 Texts — Mixtures

	Problems dealing with MIXTURES	Bonny-Castle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne-Downey 1	Milne Downey 2	Engelhardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1.	${}^{\$}Ax+{}^{\$}B(C-x)=({}^{\$}D)C$ Nuts at $\overset{\$}{A}$ + Nuts at ${}^{\$}B$/lb. To make C lbs. at $\overset{\$}{D}$. Also {Grain Tea Candy Coffee.			85-33	32-61			72-1, 73-4		58-2 241-2	6
2.	${}^{\$}Ax+{}^{\$}B(C)={}^{\#}D(x+C)$ Am't at ${}^{\$}A$ To Mix with $C^{\#}$ at ${}^{\$}B$ To give Mixture at ${}^{\$}D$								135-14,15	58-1	3
3	$\frac{ax}{b}-A+\frac{x}{c}+\frac{B}{d}+C=x$ Find amount of Gunpowder, Given amount of ingredients.		88-29								1
4	$A(\%)(B+x)=x+C(\%)B$ Alcohol To be added to B gal. of C(%) Mix, To give A(%) Mix.									58-3,4	2
5	$A(\%)B=(x+B)D(\%)$ Water to be added to B pints at A(%) To give D(%) Solution. {Alcohol, Silver Alloy, etc. Salt, Amonia, Glycerine						107-58,60	72-2,3 73-6 75-2,6 76-10		241-4,5,6,8,9	13
6	$A(\%)x+B(\%)(M-x)=C(\%)M$ A(%) ore and B(%) ore are Mixed To get M tons of C(%) ore							73-5		241-1	2
7	$A(\%)(B+x)=C$ B# of 2 ores has C# of 1 {find am't of other for A(%) ALLOY}						106-56 107-57				2
8	$Mrx+Mx+x+\overset{nr}{M}=P$ P# of bronze has M Times as Much Tin as zinc, + n# less Than $\frac{1}{r}$ That of Copper. Find zinc						107-59				1
9	$A(\%)C+x=(C+x)B(\%)$ am't pure gold To add to C oz. A(%) fine To make it B(%) Fine						107-61,62				2
10	$C=x+(x+A)+(ax+A)$ Amount of Brandy, wine and water in cask.		88-30								1
11	$(A\text{¢})(x+B)+(C\text{¢})x=(D\text{¢})(x+x+B)$ Mixture 2 bluegrass Seed at (D¢). B# more of (A¢) Than (C¢)						107-63				1
12	$A(\%)x=B(\%)C$ # pints A(%) Acid & water To make C pints of B(%) Solution									241-3,7	2
12	Totals	0	2	1	1	0	8	9	2	13	36

Table VII. Money

Table VII. Analysis of Algebra Problems in One Unknown – 9 Texts – Money

	Problems Involving MONEY	Bonnycastle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne Downey 1	Milne Downey 2	Englehardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1	$(\frac{ax}{b}+A)-\frac{c}{d}(\frac{ax}{b}+A)+B=\frac{x}{n}-B$ Son spends part of money left him, loses some, then earns some more			85-38							1
2	$x+(x-A(\%)B)=C-x+(C-x\cdot A(\%)D)$ Money in bank for 2 girls of different ages, so that they have same at 21			81-10							1
3	$(ax-c)\frac{a}{b}=\frac{x}{d}$ Money of 1 man			86-39							1
4	$x+ax-A=B$ " " 2 men								136-17		1
5	$a(\$A-x)=\$B+x$ Amount 1 man pays 2nd				36-62						1
6	$A-x=x-B$ Money of 2 men, one has more than other							46-5			1
7	$\frac{a}{b}(x+A)=\frac{x}{c}$ Number of Shillings to 2 men.			86-44							1
8	$ax=C-x$ Money of 2 men, 1st has "a" times 2nd.							46-7			1
9	$ax=x+\$A$ Sum divided among 3 men.				31-51						1
10	$\frac{T}{x}-A+B=C$ Money of 3 men, given in pairs. Find each.				31-45						1
11	$\frac{x}{a}+\frac{c-x}{b}=K$ Money divided among 5 men, 7 women.			88-57							1
12	$A(\frac{ax}{b})-A(\frac{cx}{d})=K$ 2 men have same income, diff. debts.		88-25								1
13	$x=A+\frac{x}{a}+\frac{x}{b}+B$ Find income of man.		88-28								1
14	$\frac{x}{a}-A=\frac{b}{c}(x+B)$ Income of newpaper reporter.					192-15					1
15	$(x-\$A-\$B)D(\%)=\$C$ Given exemptions on income and tax							78-28			1
16	$\frac{ax}{b}+\frac{x}{c}+A=x$ Amount of money man had after part spent.							75-4			1
17	$\frac{x}{a}+\frac{x}{b}+\frac{x}{d}=C$ Sum of money in parts		87-17								1
18	$x+(\frac{x}{a}-C)=\frac{b}{d}(\frac{x}{a})$ Man finds sum = part of what he had			85-34							1
19	$x-\frac{x}{a}=C$ Man lost part of money and had "\$C" left			85-35							1
20	$x+\frac{ax}{b}=C$ Money lent to friend.			86-42							1
20	Totals	0	3	8	3	1	0	4	1	0	20

Table VIII. Numbers

Table VIII Analysis of Algebra Problems in One Unknown - 9 Texts - Numbers

	Problems to Solve for NUMBERS	Bonnycastle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne Downey 1st	Milne Downey 2nd	Engelhardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1	$\frac{a}{b}(x \pm A)=C$ Part of a Number + A equals a Constant		87-22	87-46							–
2	$x+\frac{x}{a}-C=\frac{x}{b}$ " " " " + Number − Constant = $\frac{x}{b}$		84-2								1
3	$\frac{x}{a}+\frac{C-x}{\ }=K$ Number divided into 2 parts		85-4								1
4	$x=\frac{bd^{b}-ah}{h}$ " equals certain Fraction		85-5								1
5	$ax=x+A$ "a" Times a number = number + Constant				27-4						1
6	$ax=C$ Product of 2 Numbers				28-10						1
7	$ax+A=B$ " " " " + Constant				28-12						1
8	$(x-A)A=(x-B)B$ Number − 1constant x Same.				30-43						1
9	$(ax-A)b=(Cx+B)d$ Similar				31-44						1
10	$d(x-A)=b(x+B)$ "				31-53						1
11	$ax-A=A-bx$ Number exceeds number by as much as.				32-55						1
12	$\frac{A+\frac{x}{a}}{x}=\frac{b}{c}$ Fraction = Number						101-6				1
13	$\frac{x}{x+A}=\frac{a}{b}$ Same { Number is subtracted or					192-17,18	101-5	77-25		55-1	7
14	$\frac{x-A\pm B}{x\pm B}=\frac{a}{b}$ " added to Numerator, etc.					192-19	101-7				
15	$\frac{x}{A+bx}=\frac{a}{c}$ Same		87-13								1
16	$\frac{x}{a}+a+x=C$ Quotient, dividend, & Divisor = Constant		86-8								1
17	$\frac{a+x}{b}=\frac{c}{b}$ Number added to Numerator of Fraction							75-5			1
18	$\frac{A+x}{B+x}=\frac{a}{b}$ " " both " and denominator		90-39					76-8			2
19	$dx+B-C=D-ax$ { part of Number exceeds Number			88-60							1
20	$A-x=\frac{x}{a}-B$ by as much as other part is less. "		86-10					75-7			2
21	$a(\frac{x}{b}+\frac{x}{c})=C$ Product of Sum of 2 parts = Constant						101-8				1
22	$\frac{ax}{b}+x=C$ Part of Number and Number = "			79-2							1
23	$\frac{ax}{b}+\frac{x}{d}=C$ Sum of 2 Parts of " = "			79-4				76-14			2
24	$\frac{x}{a}-\frac{x}{b}=C$ difference of 2 " " " " "		87-15,20	81-9 84-22			101-3,4	74-1			7
25	$x^2=(x+A)^2$ difference of Squares of 2 Numbers equal	-3									1
26	$(x+A)^2-x^2=C$ Similar			84-6				75-6,9			3
27	$\frac{x+A}{\frac{ax}{b}+A}=\frac{c}{d}$ 2 Numbers + a Constant = Fraction		90-44								1
28	$A-x\pm B=ax$ Number in 2 Parts.				27-6,7 29-25			75-2			4
29	$(C-x)+\frac{x}{d}=x-A$ Similar							76-15			1
30	$\frac{a}{b}(x+x+A)=B$ Part of difference of 2 Numbers = C.						101-2				1
31	$ax-A=b(C-x)+B$ 2 Numbers diminished and Increased								128-4		1
32	$ax=x+A+B$ Similar								128-5		1
33	$a(x+A)=bx$ 2 Numbers "a" Times 1 = "b" Times other			85-32							1
34	$\frac{C-x+A}{x+B}=\frac{a}{b}$ " " = ratio if something added		90-43	85-31							2
35	$\frac{ax}{b}=\frac{c}{d}(D-x)+M$ Number divided in 2 parts	-2		84-25 87-47				75-4			4
36	$x-A=[B-(C-x)]d$ Same		90-46	87-48							2
37	$a(C\pm x)=bx$ Same		86-11	85-29,30	29-31						4
38	$x+ax=C$ Same			83-19				46-1			2
39	$A-x=x\pm B$ Two Numbers				27-2,3,5 28-20		101-1 102-12	46-2,3,4 47-16			10
40	$\frac{ax}{b}=\frac{c}{d}(A-x)$ Number in 2 parts							75-8			1
41	$x-A=(C-x)-B$ Same								127-2 128-3		2
42	$ax=b(\pm x\pm A)+B$ Same				28-11, 30-35 29-30,32				127-1 128-8		6
43	$A-x=ax+ax-B$ Same				32-56						1
44	$\frac{ax}{b}-(C-x)=A$ Same							76-13			1
45	$C-a(x+A)=B-bx$ 2 Numbers								128-7		1
46	$\frac{C\pm x}{x}=\frac{ax+B}{x}$ Number in 2 parts - 1 divided by other							77-19,26	134-3,4,5, 6,7,8.	55-2	9
47	$\frac{x-(A-x)}{a}=\frac{b}{c}$ " " " "						101-9 102-10				2
48	$\frac{x}{a}=\frac{x_1}{b}=\frac{C-(x+x)}{c}$ " " 3 " - Fractions of each =		91-48								1
49	$\frac{x}{a}+\frac{x}{b}+\frac{cx}{d}=C$ Parts of Number = Constant		88-27								1
50	$x=a(A-x)$ → One Number "a" Times other				27-1		102-11				2
51	$\frac{10aT+T-B}{10aT-T}=C$ 2-digit Number − divided by sum or difference of digits.					194-31					1
52	$\frac{10T+(T+A)+C}{(aT+A)}=B$ Same					194-30					1
53	$\frac{10\frac{T}{a}+T+A}{\frac{T}{a}+T}=C$ Same − 1 digit fraction of other.					194-32					1
54	$x+x+1=A$ 2 consecutive numbers = Constant							75-3			1
55	$(x-1)+x+(x+1)=(x+1)+A$ 3 Consecutive Numbers							46-8			1
56	$(x-1)+x+(x+1)=a(x-1)-A$ Same								128-6		1
57	$(x-1)+x+(x+1)=C$ Same				27-8			46-11,13		55-3	4
58	$(x-2)+x+(x+2)=C$ 3 consecutive Even Numbers							46-10		55-4	2
59	$(x-2)+x+(x+2)=(x-2)+x+A$ same							46-9		5	1
60	$C-x+x-A+x+B+x-D+x+E$ Number in 5 parts or 5 consecutive Numbers		89-32		27-9						2
61	$a(x+2)^2-[x^2+(x-2)^2]=A$ 3 consecutive odd Numbers									55-1	1
61	Totals	2	17	15	23	6	12	26	14	5	120

Table IX. Analysis of Algebra Problems in One Unknown – 9 Texts – Percentage

	Problems in PERCENTAGE	Bonny-Castle 1808	Day & Thompson 1854	Green-leaf 1867	Went-worth 1906	Milne Downey 1	Milne Downey 2	Englehardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1	$x+\frac{x}{a}+(x+A)=C$ % of different races in total population					194-29					1
2	$\frac{A-B+(C-x)}{A+C}=D(\%)$ Number of Baseball Games to win for certain (%)							76-18 78-29			2
3	$A(\%)x=C\pm x$ steel for casting Cost of Book or Radio							67-1 68-7,8			3
	Population of City } Now and Then							68-3			1
	Enrollment of Jr. H. sch. } Now and Then							68-4			1
4	$A(\%)C=x$ Enrollment of Jr. H.S. Now & later							68-5			1
5	$A(\%)x=C$ % of eggs hatched in incubator							68-2			1
6	$A(\%)B\cdot C={}^{\$}D-{}^{\$}B$ Rate of interest							68-6			1
7	$A(\%)x=x-{}^{\$}C[B(\%)+1]$ Sales price of Article							78-31			1
7	Totals	0	0	0	0	1	0	11	0	0	12

Table X Uniform Motion

Table X. Analysis of Algebra Problems in One Unknown - 9 Texts - Uniform Motion

	Problems in Uniform Motion	Bonnycastle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne Downey 1	Milne Downey 2	Englehardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1	$ax=b(x\pm A)$ #hours going upstream and back or Time for 1 vehicle to overtake another		89-35		30-42		104-31	69-3 77-23 69-1	132-23,24,25 133-32,33	240-4	2 10
2	$x=12(x-A)$ when A = The number of minutes to hour. Time between 2 hours when hands of clock are together - opposite	-1						75-3 76-12			3
3	$ax+a(x+A)=C$ Rates of 2 Vehicles going in opposite directions							76-9	133-30 133-31		3
4	$ax+b(A-x)=e$ Rates of a vehicle or 2 Trains between 2 points				31-50			70-5		56-3	3
5	$ax=b(A-x)$ Number of Miles covered walking to a point & riding back - or going up river and back.				30-41		103-28 104-30 104-33	69-2			5
6	#minutes before second hand is between other 2-3 on Pivot			88-59							1
7	$\frac{x}{c-x}=\frac{a}{b}$ Two men meeting, distance they travel		87-18								1
8	Distance covered by workman before explosion								136-20		1
9	$\frac{ax}{b}+A=C-x$ distance covered by 2 balloons in race					192-14					1
10	$Ax+Bx=C$ Number of days before 2 men at different rates will be "c" miles apart.				28-16 29-26	195-43			132-26 132-27	56-1,2 240-3,6	9
11	$R_1T_1=x\frac{aT_1}{b}$ Rates of man going and coming									240-2,5	2
12	$\frac{Aax}{b}=(B+cx)a$ Grey hound chasing fox. number of leaps before fox is caught			88-56							1
13	$x+A-B+C-D=K$ Latitude of boat		86-7								1
14	$\frac{x}{x-A}=\frac{a}{b}$ 2 Boats passing fort at different rates		87-14								1
15	$\frac{A}{x+B}=\frac{c}{x-B}$ Rate of rowing boat with or against current				31-49 32-59			76-11			3
16	$a(x+B)=b(x-B)$ Velocity of current - by boat						103-29				1
17	$\frac{A}{\frac{ax}{b}}=\frac{A}{x}+B$ Rate of 2 Trains - same direction							77-20			1
18	$(A-B)x=C$ Rate of Bullet - or 2 men in same way				28-17			69-4	133-28,29		4
19	$a\cdot A=x(A\pm B)$ Rate of 2nd man or train							70-6			1
20	$\frac{A}{x}=\frac{A+B}{x+C}$ Speed of 2 Trains					195-36				240-1	2
21	$R\cdot T_1=x\cdot T_2$ Similar					195-37				56-4	2
22	$ax=\frac{b}{c}(x+A)$ Similar							78-30			1
23	$T_1x=T_2(x+\frac{a}{b})$ Rate/minute of 1 Train					195-38					1
24	$A-x=x+B$ Velocity of Tide by boat				32-60						1
24	Totals	1	4	2	9	5	5	13	12	10	61

Table XI. Analysis of Algebra Problems in One Unknown – 9 Texts – Value

	Problems of VALUE	Bonny-Castle 1808	Day & Thompson 1854	Green-leaf 1867	Went-Worth 1906	Milne Downey 1	Milne Downey 2	Engelhardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1	$x+ax=C$ Horse and chaise are Worth Sum, Chaise worth "a" Times horse			81-8							1
2	$\frac{a}{b}(x+C)=dx$ Value of Saddle which is Fraction The Value of horse			82-11							1
3	$\frac{ax}{b}+x=C$ Two Estate are worth Sum, 1 is worth only Fraction of other			79-3							1
4	$x+ax+(x+ax)=C$ Value of 2 Carriages and horse, 1 Carriage "a" times other			82-13							1
5	$x+ax+b(x+ax)=C$ Horse worth "a" Times harness, chaise "b" Times both together		90-40								1
6	$\frac{ax}{b}(A\%)+\frac{cx}{d}(B\%)+\frac{ex}{f}(C\%)=K$ Value of Property invested in parts					195-42					1
7	$x+\frac{x}{a}-A+B=C$ Value of Estate if Part is lost, and sum is added.			86-43							1
8	$A+x=\frac{a}{b}(\frac{cx}{d}-A)$ 2 Farms and stock Value of Stock given, Find Farms			88-58							1
9	$A+x=\frac{a}{b}(cx-A)$ 2 Horses and saddle. 1 Horse + saddle = Fraction of other			87-51							1
10	$x+A-B=C$ Man Makes several Bargains, does he gain or lose?		86-6								1
10	Totals	0	2	7	0	1	0	0	0	0	10

Table XII. Work

Table XIII
Miscellaneous

Table XII Analysis of Algebra Problems in One Unknown - 9 Texts - Work

	Problems of WORK	Bonnycastle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne Downey 1	Milne Downey 2	Engelhardt Haertter 1929	Longley Marsh 1929	Wells Hart 1929	Totals
1	${}^{8}Ax-{}^{8}B(l-x)={}^{8}C$ Laborer works for pay, when he is idle he pays forfeit. find days working and idle			84-23	29-28						2
2	$1-a(\frac{1}{b}+\frac{1}{a})=x$ $(\frac{x}{\frac{1}{b}}=\text{Ans})$ Time to take 2nd Man to do job, if 2 do it in certain Time.							71-3 71-6			2
3	$\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{2}{x}$ $\frac{2}{x}-\frac{1}{a}=\frac{1}{A}$ Find the Time it Take each to do job, if 3 Together do it in certain Time					194-27 194-28	103-24 103-25				4
4	$\frac{1}{a}+\frac{1}{x}=\frac{1}{b}$ Time for 1 To do job, if Time it requires 2 is given. also Time of 2nd.			87-49 87-50				71-2 71-5			4
5	$\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=\frac{1}{x}$ Time for 3 To do a job Together.					193-24		75-5 77-24			3
6	$\frac{1}{a}+\frac{1}{b}=\frac{1}{x}$ How long will it take 2 To do a job if each can do it in a certain Time?			83-12 87-53		193-23, 25, 26	103-21, 22 27	71-1, 4 76-7			11
7	$\frac{1}{a}+\frac{1}{b}-\frac{1}{c}=\frac{1}{x}$ Time Required To fill tank if 2 Pipes Flow in and one Flows out.						103-26				1
8	$x(A+B+C)=D$ Number of hours for 3 Men to do a Job Also for 3 Pipes To Fill Tank				30-36 30-37						2
8	Totals	0	0	5	3	6	6	9	0	0	29

Table XIII. Analysis of Algebra Problems in One Unknown - 9 Texts - Miscellaneous

	MISCELLANEOUS										
1	$C-x-A=\frac{ax}{b}$ Weight of shell and powder used in Gun					191-3					1
2	$x=\frac{ab}{c}$ Tons of Steam used Per hour on Boat.					191-4					1
3	$\underbrace{\left(\left[x-A+\frac{x-A}{a}\right]-A+\left[\frac{ax-aA+x-A}{a\cdot a}\right]-A\right)}$ $+\left[\frac{\qquad\qquad}{a\cdot a\cdot a}\right]=bx$ A Merchant adds part of his Savings each year		91-49								1
4	$Aax+Bx=C$ Gallons per minute pumped by 2 different sized pumps.					191-7					1
5	$\frac{x+A}{\frac{(\pounds\ B)x}{\pounds C}+A}=\frac{a}{b}$ Find the lengths of 2 different sized Pieces of cloth at Same (£) Price/yard.		89-37								1
6	$A-x=B-\frac{ax}{b}$ Bottle weighs more when filled with Liquid than when filled with water - Find weight							76-17			1
6	Totals	0	2	0	0	3	0	1	0	0	6

Explanation of table XIV.

This table is a summary of the thirteen tables preceeding. It shows the total number of each type of problem appearing in each book. Vertically are listed the various types, and horizontally are the names of the different books.

The first column headed "totals", shows the total number of each type in all the books. for example, referring to table XIV, p. 29 the first "total" column shows that there are 14 "age" problems in all the books taken together, 11 "cost" problems, 50 "distribution" problems, etc.

The final "total" column, shows the total number of problems under each type in all the books. for example, referring to the table, page 29, we can see that there are 28 problems of the "age" type in all the books, 14 problems of the "cost" type, 62 of the "distribution" type, etc.

Explanation of chart I. page 29b.

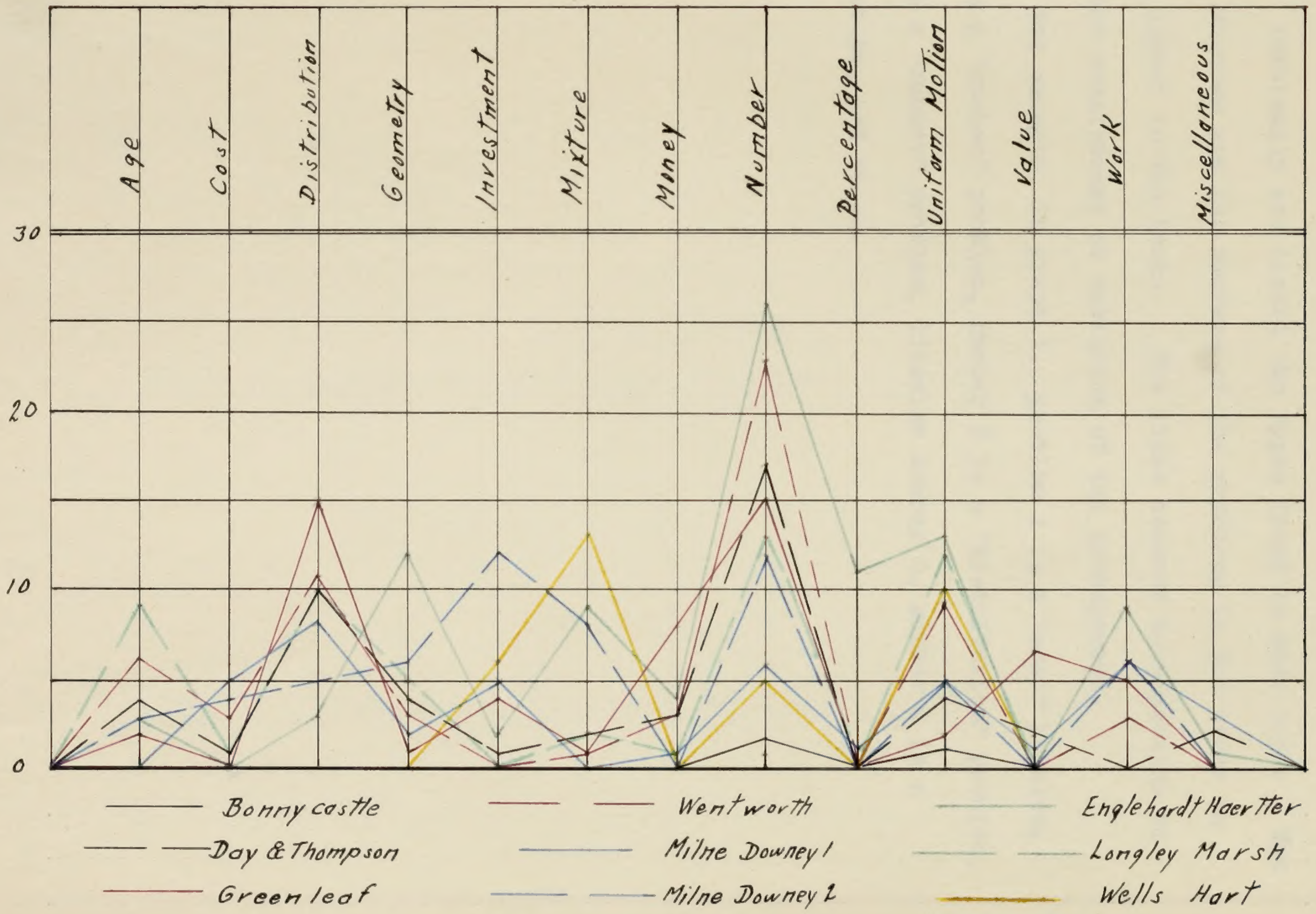
This chart is a frequency chart, and is compiled from the summary table (table XIV., page 29). It shows the variation in the number of each type, graphically. The different types are listed horizontally, and the number (totals) of each type, according to texts, are listed vertically.

The textbooks are represented by the different colored lines. Each horizontal line represents five problems. for example, referring to chart I., page 29b, we find that there are 26 "number" problems in Englehardt & Haertter; this book being represented by the solid green line.

Table XIV. Summary of Types and Problems

Types	Number of each type	Bonnycastle 1808	Day & Thompson 1854	Greenleaf 1867	Wentworth 1906	Milne Downey 1	Milne Downey 2	Englehardt Haertter 1929	Langley Marsh 1929	Wells Hart 1929	Total Problems each Type
AGE	14	0	4	2	7	0	3	3	9	0	28
COST	11	0	1	0	3	5	4	0	1	0	14
DISTRIBUTION	50	0	10	15	11	8	5	3	10	0	62
GEOMETRY	22	0	4	1	3	2	6	12	5	0	33
INVESTMENT	16	0	1	4	0	5	12	2	0	6	30
MIXTURE	12	0	2	1	1	0	8	9	2	13	36
MONEY	20	0	3	8	3	1	0	4	1	0	20
NUMBERS	61	2	17	15	23	6	12	26	14	5	120
PERCENTAGE	7	0	0	0	0	1	0	11	0	0	12
UNIFORM MOTION	24	1	4	2	9	5	5	13	12	10	61
VALUE	10	0	2	7	0	1	0	0	0	0	10
WORK	8	0	0	5	3	6	6	9	0	0	29
MISCELLANEOUS	6	0	2	0	0	3	0	1	0	0	6
Totals	261	3	50	60	63	43	62	93	54	34	461

Chart I - Frequency Chart



Explanation of the graphs.

These graphs show the arrangement and sequence of the problems. Vertically are listed the types found in each book. The horizontal figures are the numbers of the problems in the order in which they appear in the books. The lines connect each problem to emphasize the consistency or variation of the arrangement.

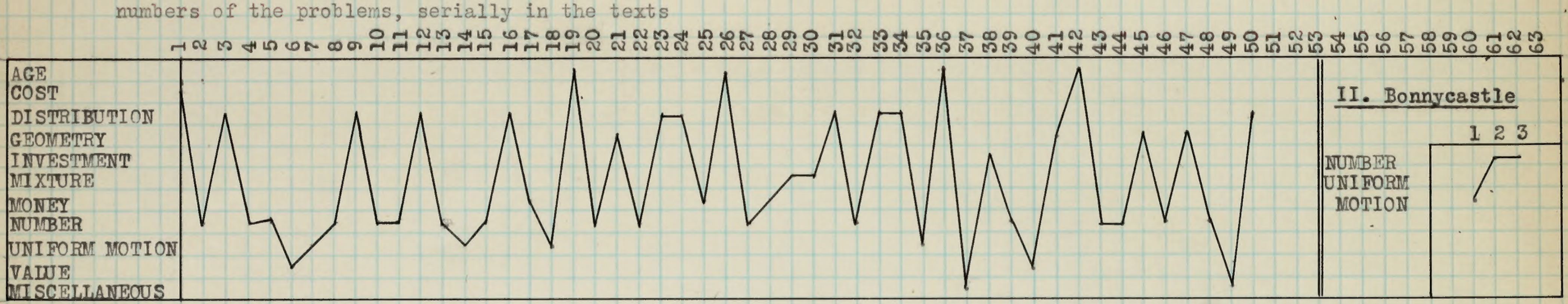
For example, in graph I., problem 1 is a "cost" problem, number 2 is a "number" problem, number 3 is a "distribution" problem, number 4 is a "number" problem, likewise number 5, number 6 is a "value" problem, and so on.

Explanation of the graphs.

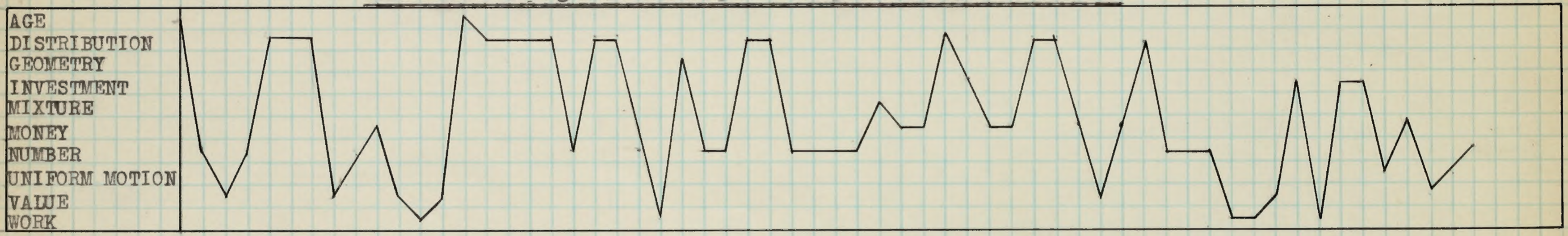
These graphs show the arrangement and sequence of the problems. Vertically are listed the types found in each test. The horizontal figures are the numbers of the problems in the order in which they appear in the tests. The lines connect each problem to emphasize the consistency or variation of the arrangement.

For example, in graph I., problem 1 is a "unit" problem, number 2 is a "fraction" problem, number 3 is a "distribution" problem, number 4 is a "property" problem, likewise [illegible], number 5 is a "value" problem, and so on.

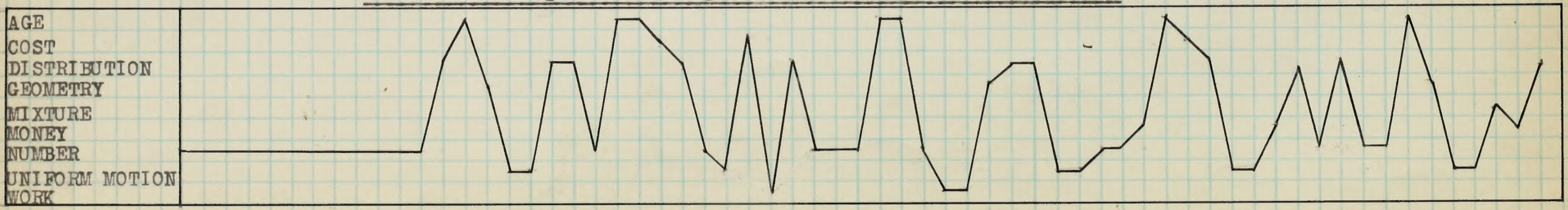
GRAPH I. Arrangement and Sequence of Problems in Day and Thompson



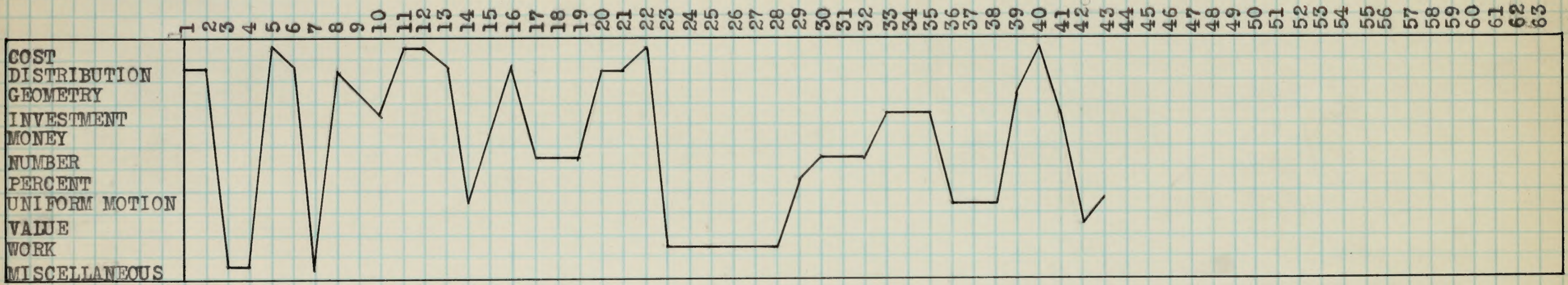
GRAPH III. Arrangement and Sequence of Problems in B. Greenleaf



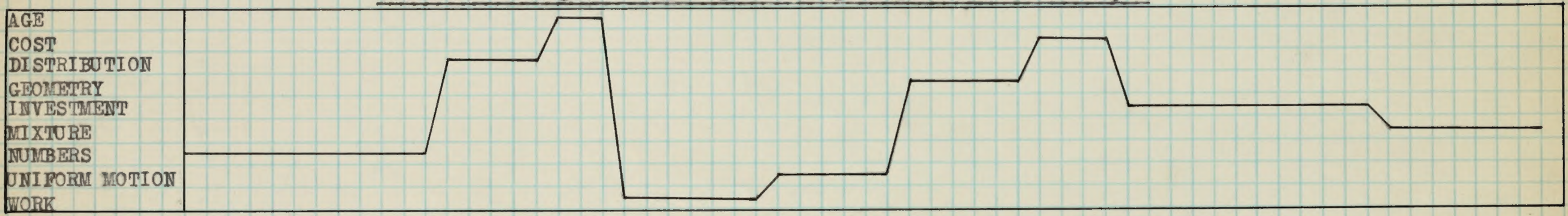
GRAPH IV. Arrangement and Sequence of Problems in G.A.Wentworth



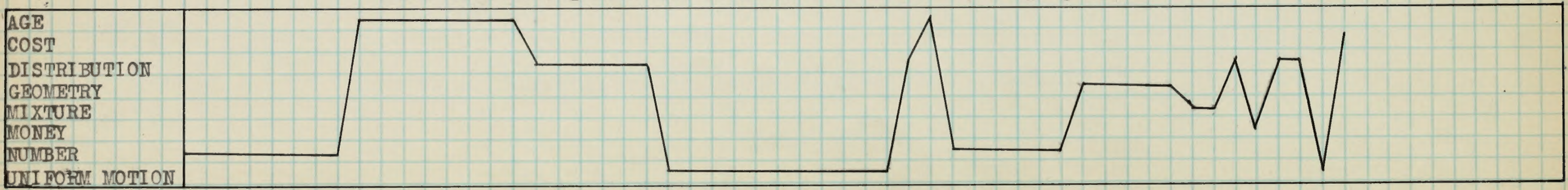
GRAPH V. Arrangement and Sequence of Problems in Milne-Downey 1



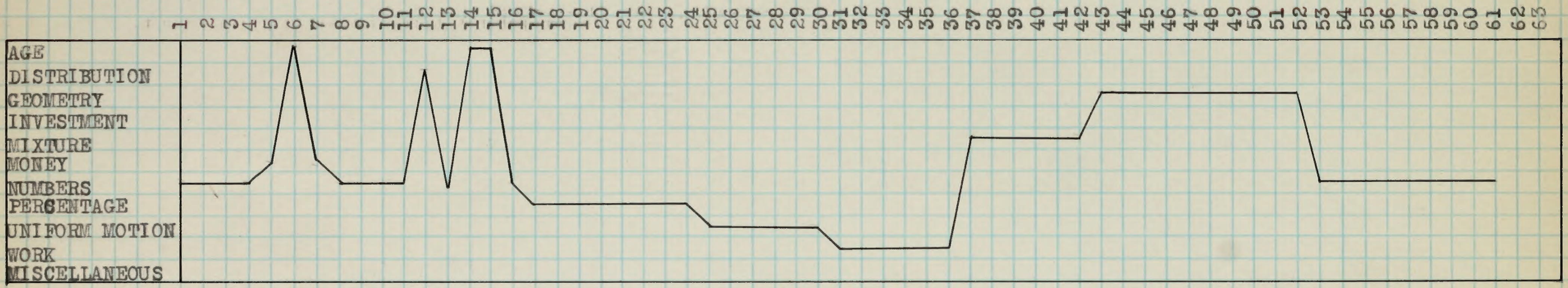
GRAPH VI. Arrangement and Sequence of Problems in Milne-Downey 2



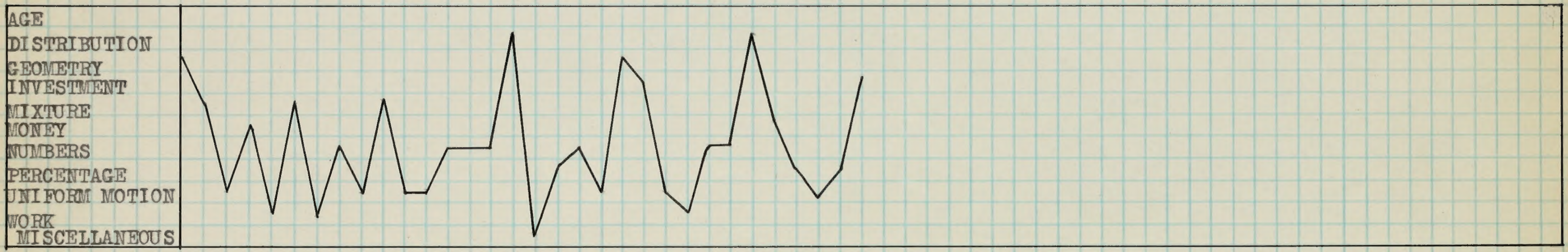
GRAPH VII. Arrangement and Sequence of Problems in Longley-Marsh



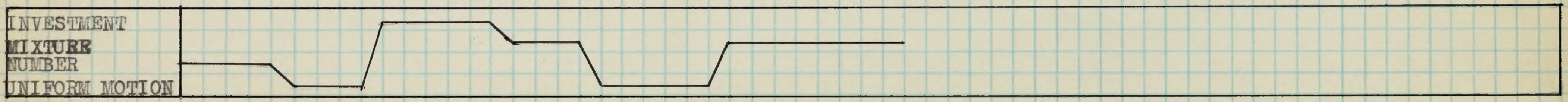
GRAPH VIII. Arrangement and Sequence of Problems in Englehardt and Haertter



GRAPH VIII. (Cont')



GRAPH IX. Arrangement and Sequence of Problems in Wells and Hart



III. Discussion of the textbooks and problems.

It is interesting to note that in the older books, previous to 1875, the subject of fractions was introduced before the work on Linear equations. This arrangement made it possible for the authors to include many complicated fractional equations in their problems. The later authors have not given as much space to fractions, and include them after the work on simple equations. In some cases, as in Engelhardt and Haertter, there is a page of introductory material on fractions, which comes in the middle of the chapter on equations, to enable the pupil to solve fractional linear equations. The other authors either leave out the subject altogether, or have a group of fractional equations following the chapter on fractions.

In working through the different problems it has been found that the authors keep pretty close to the trend of the times. This is evidenced best by a study of similar problems in succeeding books. The earlier texts have one man overtaking another on foot as the subject for "uniform motion" problems. Later the men were on horseback. During the middle of the last century, when the stage-coaches were the popular means of transportation, it was one overland express pursuing another. As we enter the twentieth century we find trains and bicycles overtaking one-another, and the modern texts employ automobiles and airplanes as subjects of time, rate, and distance problems.

In the "distribution" and"Value" problems we find an evolution from shillings, horses, harnesses, and chaises, to dollars, automobiles, and theater tickets.

A glance at the frequency chart, page (28), shows that there

is practically no uniformity or system in selecting certain types of problems to be inserted in the textbooks. The "number" type appears most often, except in Milne and Downey, "First Course in Algebra," and Wells and Hart, "Modern Second Course in Algebra." In the other books there are nearly twice as many "number" problems as other types.

The next type in order of frequency are the "distribution" problems. These were more popular in the early books than they seem to be in the modern ones, although Longley and Marsh include quite a number of them.

There are as many "uniform motion" problems as there are "distribution" ones. But the use of the former is increasing as rapidly as the latter is decreasing. There is considerable interest in the "uniform motion" problems, particularly as most families have cars of their own and are interested in figuring the time needed to reach a point.

The "mixture" problems are also more or less recent, and rank next in the order of frequency.

The other types are scattered throughout the various texts. In preparing the "percentage" table the writer has followed the classification of the authors of the textbooks concerned. This is in line with the work throughout the thesis. A slight variation may be noted here as Engelhardt and Haertter, the authors of one of the texts, have included as "percentage" problems problems which have been grouped as "cost", "distribution", and "investment" problems by the writer and by the other authors.

The general practice among the modern authors is to make the problems as understandable as possible. All unnecessary and misleading words and figures are omitted. However, none of the essential facts have been discarded for the sake of brevity, but rather a better

phraseology has been developed.

The problems are also much easier to solve. It is not the purpose to present the pupils with problems which require only a few moments and steps to solve, but rather to provide them with problems which have a degree of difficulty, although not as great a degree as was presented by some of the older problems. The time should be allotted to solving many types, rather than puzzling over two or three trick problems. The problems in the newer textbooks can be reduced to much simpler equations than could some of those in the older books.

It is hard to find any practical value to some of the earlier problems. Probably their only use was for formal discipline as has been suggested before. The authors of the latter editions are making their problems much more interesting as well as more practical.

If one makes a careful study of the graphs (p. 30,31,32) which show the arrangement and sequence of the problems they will notice that, with the exception of Bonnycastle, which can hardly be taken into account in this study, the oldest books had no logical sequence. The "sawtooth" lines show that the authors jumbled their problems together and only occassionally placed two problems of the same type together. This system may have had its advantages when it was first introduced, but it has probably been improved upon by the later authors.

Wentworth's book shows a beginning of the present practice when it has 12 "number" problems grouped in sequence. There are also other small groups of associated problems throughout the set.

The graph of Milne and Downey's Second Course presents a series of straight lines of some length. This is because the problems

are arranged according to types; each type having an explanatory problem at the beginning to illustrate the principles involved.

Engelhardt and Haertter's book seems to vary from the modern trend, but this appearance is due to two facts. The first problems listed probably should have been omitted from this study as they come a little before the others, but they are of the general types and so were included. The last group of problems are classified by the authors as a miscellaneous group, and so rightly give a scattered graph.

Wells and Hart confine themselves to a very few select problems of several types which are introduced by illustrated examples; similar to the other books. Then in the back part of the book they include several pages of additional problems to be done if the pupil requires more practice on some specific type, or if the teacher wishes to extend the work on problems.

IV. Conclusions.

The study of these various textbooks shows that the trend of the authors of algebra books is towards simplification, practicability, and modernization. This is being attained by using subjects comparable to the present times; by using problems which relate to further use; and by eliminating all freak and trick problems.

The practice of the present time is to present the problems in groups by types with an illustrative problem in each type preceding the practice work. A miscellaneous group is added at the discretion of the author, in which the types are mixed together. A variety of types is sought rather than a large number of any one kind.

APPENDIX

The purpose of this appendix is to provide statements in full for each of the various types in the tables. This was necessary to enable one unversed in the language of algebra to interpret properly the tables.

The problems are arranged in groups according to types as in the tables, and numbered to correspond with the number in the table. For example, the 14"age" problems listed on pages 40 and 41, correspond to the 14 types in table I, page 16. Then follows type problems for table II, etc.

The statements as listed here are taken from the various texts analyzed. In cases where there were several problems of one type listed the least complicated example has been used.

Appendix

Table 1. Age Problems. - one of each type.

1. A gentleman stated that his age was twice that of his oldest son, and that the sum of their ages was 72 years. Required the age of each. (for the source of these problems refer to table I p. 16)

2. The age of A is double that of B, and the age of B is triple that of C, and the sum of all their ages is 140. What is the age of each?

3. A gentleman lived single one quarter of his whole life; and after that he was married, and after 5 years more than one seventh of his life, he had a son who died 4 years before him, and who reached only half the age of the father. To what age did the father live?

4. The sum of the ages of a father and his son is 60 years, and the father's age is 3 years more than twice the age of his son. Find the age of each.

5. Harold is n times as old as his brother George; r years ago Harold was m times as old as George. It is required to find the age of each.

6. Ruth is 3 years older than Mary. 15 years ago Ruth was twice as old as Mary. How old is each now?

7. John is 15 years older than Frank. In 5 years Frank's age will be one half John's age. What is the age of each?

8. George is one half as old as his father; "a" years ago he was one third as old as his father. What is the age of each?

9. The sum of the ages of A and B is 40 years. Eight years ago A was twice as old as B. Find their present ages.

10. A man is 42 years old, and his son is 18. How many years ago was the father three times as old as his son ?

11. A man is four times as old as his son; in 18 years he will be only twice as old. Find the age of each.

12. Ten years ago A was three times as old as B and ten years hence he will be 18 years less than twice as old as B. Find the age of each.

13. A man spent one-third of his life in England, one-fourth of it in Scotland, and the remainder of it, which was 20 years in the United States. To what age did he live?

14. A man has 6 sons, each of whom is 4 years older than his next younger brother; and the eldest is three times as old as the youngest. What is the age of each?

Table II. Cost Problems. - one of each type.

1. A man being asked how much he gave for his watch, replied; If you multiply the price by 4, and to the product add70, and from this sum subtract 50, the remainder will be equal to 220 dollars.

2. A grocer paid $8.50 for a molasses pump and 5 feet of tubing. He paid 12 times as much for the pump as for the tubing per foot. How much did the pump cost? the tubing? (refer to table II p. 17)

3. A loin of beef was sold for 11¢ more than twice its cost. If the gain was $101\frac{3}{8}\%$, what was the cost?

4. Ann paid $3.00 for three books. The first cost $\frac{1}{2}$ as much as the second and $\frac{1}{3}$ as much as the third. Find the cost of each.

5. Cornstalk paper costs $\frac{1}{3}$ as much as paper made from rags. A ton of the former costs $50 less than a ton of the latter. Find cost of each.

6. A dealer bought 25 dozen oranges for $9.25. For a part he paid 40 cents a dozen and for the remainder 35 centsa dozen. How many doz-

en of each kind did he buy?

7. The cost per mile of running a train was \$.14 less with electrical equipment than with steam, or $\frac{3}{5}$ as much. Find cost with electricity.

8. A dealer buys 30 tons of coal and 40 cords of wood for \$400. The coal costs twice as much per ton as the wood sosts per cord. How much does he pay for a ton of coal and how much for a cord of wood?

9. A farmer bought 16 sheep. If he had bought 4 sheep more for the same money, each sheep would have cost him one dollar less. How much did he pay for a sheep?

10. At two stations, A and B, six miles apart on a line of railway, the prices of coal are \$10 per ton and \$12 per ton, respectively. THE rates of cartage of coal are \$1 per ton per mile fnom A and \$1.50 per ton per mile from B. Find the distance from A of a place on the railroad from A to B at which a consumer lives if the cost of a ton of coal is the same whether delivered from A or B.

11. It cost 3.6¢ less to travel 100 miles in one automobile than it did to travel 80 miles in another. The average cost per mile of the former was 1.9¢ less than the average cost per mile of the latter. Find the cost per mile of each.

Table III. Distribution Problems.- one of each type.

1. A boy has 9 more quarters than dimes, and in all has 57 coins. How many coins of each kind has he? (refer to table III p. 18)

2. A man has \$1.10 in dimes and nickles and he has 15 coins in all. How many coins of each kind has he?

3. How can a bill of \$2.45 be paid with dimes and quarters by using the same number of each?

4. I have \$5.00 in quarters and halves, with two more quarters than

than halves. How many coins of each kind have I?

5. I have $3.85 in quarters and ten-cent pieces and I have three times as many ten-cent pieces as quarters. How many of each kind?

6. A man has a certain number of dollars, half dollars, and quarters. The number of quarters is twice that of the half dollars, and the numbers of half dollars is twice the number of dollars. If he has $45 in all, how many coins of each kind has he?

7. John has $6.75. He has 3 times as many dimes as nickels, and as many quarters as the sum of the nickels and dimes. How many coins of each denomination has he?

8. How can I have $3.20 in dimes, quarters, and halves so that I shall have 3 times as many quarters as halves and 1 dime more than the numbers of quarters?

9. Divide a prize of $2000 into two such parts, that one of them shall be to the other as 9 to 7.

10. A prize of $1000 is to be divided between A and B, so that their shares may be in the proportion of 7 to 8; find the share of each.

11. Two men found a prize of $144, and it was agreed that B should have $30 more than A. How many dollars did each receive?

12. Divide $100 among A, B, and C, so that A may have $20 more than B, and $10 more than C.

13. Divide $21 among A,B, and C, so that A and B shall each receive three times as much as C.

14. A gentleman left an estate of $1862 for his three sons. He gave his youngest $133 less than his second son, and to his oldest son he gave as much as to the other two. How much did each receive?

15. A father divideds his estate among his three sons as follows;

The first has $1000 less than half of the whole; the second has 800 less than one-third of the whole; the third has 600 less than one fourth of the whole; what is the value of the estate?

16. A,B,and C, found a purse of money, and it was mutually agreed that A should receive $15 less than one-half, and that B should have $13 more than one quarter, and that C should have the remainder, which was $27. How many dollars did the purse contain?

17. Three man, A,B,and C, trade in company; A put in a certain sum, B put in twice that much, and C put in three times as much as both, and they gain $864. What is each man's share of the gain?

18. An estate is divided among four children, in such a manner that; the first has 200 dollars more than one quarter of the whole, the second has 340 dollars more than one fifth of the whole, the third has 300 dollars more than one sixth of the whole, and the fourth has 400 dollars more than one eighth of the whole. What is the value of the estate?

19. A certain gentleman divided his property, consisting of $5300, among his four sons, A,B,C,and D. He gave $350 more to B than to A; he gave C $400 more than B; but he gave D twice as much as he gave A and B. How much did each son receive?

20. A man met 4 beggars, to whom he gave 77 cents. To the first he gave twice as many as to the second; to the third, as many as he gave to the first and second; and to the fourth as many as he gave to the first and third. What sum did he give to each?

21. A gentleman at his decease, left an estate of $1872 for his wife, three sons, and two daughters. His wife was to receive three times as much as either of her daughters, and his sons to receive each one half as much as one of the daughters. Required the sum each received.

The first has $1000 less than half of the whole; the second has 600 less than one-third of the whole; the third has 300 less than one fourth of the whole; what is the value of the estate?

16. A,B,and C, found a purse of money, and it was mutually agreed that A should receive $12 less than one-half, and that B should have $13 more than one quarter, and that C should have the remainder, which was $27. How many dollars did the purse contain?

17. Three men, A,B,and C, trade in company; A put in a certain sum, B put in twice that much, and C put in three times as much as both, and they gain $960. What is each man's share of the gain?

18. An estate is divided among four children, in such a manner that; the first has 200 dollars more than one quarter of the whole, the second has 340 dollars more than one fifth of the whole, the third has 300 dollars more than one sixth of the whole, and the fourth has 400 dollars more than one eighth of the whole. What is the value of the estate?

19. A certain gentleman divided his property, consisting of $5000, among his four sons, A,B,C,and D. He gave $200 more to B than to A; he gave C $412 more than B; but he gave D twice as much as he gave A and B. How much did each son receive?

20. A man met 4 beggars, to whom he gave 77 cents. To the first he gave twice as much as to the second; to the third, as many as he gave to the first and second; and to the fourth as many as he gave to the first and third. What sum did he give to each?

21. A gentleman at his decease, left an estate of $1372 for his wife, three sons, and two daughters. His wife was to receive three times as much as either of her daughters, and the sons to receive each one half as much as one of the daughters. Required the sum each received.

22. Three persons, A,B,and C draw prizes in a lottery. A draws 200 dollars; Bdraws as much as A, together with a third of what C draws; and C draws as much as A and B both. What is the amount of the prizes?

23. A father divided a small sum among four sons. The third had 9 shillings more than the fourth; the second had 12 shillings more than the third; the first had 18 shillings more than the second; and the sum was 6 shillings more than 7 times the sum which the youngest received.

24. A,B,and C buy a summer cottage for $3000. B pays twice as much as A, and C pays as much as A and B together. How much does each pay?

25. Four persons purchase a farm in company for $4755; of which B paid three times as much as A; C paid as much as A and B; and D paid as much as C and B. What did each pay?

26. Ten men agreed to buy a camp together, but two declined to take their share, and each of the others had to pay $5 more for his share. What was the cost of the camp?

27. A drover has a lot of oxen and cows, for which he gave $1428. For the oxen he gave $55 each, and for the cows $32 each, and he had twice as many cows as oxen. Required the number of each.

28. A boy bought apples, oranges, and pears; he gave two cents apiece for the apples, three cents for the oranges, and fours cents for the pears. He had twice as many oranges as apples, and three times as many pears as oranges. The sum he expended was $2.24; how many of each kind?

29. Of the trees in an orchard, $\frac{3}{4}$ are apple trees, $\frac{1}{10}$ pear trees, and the remainder peach trees, which are 20 more than $\frac{1}{8}$ of the whole. What is the whole number of trees in the orchard?

30. A man sold a quantity of wood for $49, half of it at $3 a cord and the other half at $4 a cord. How many cords did he sell?

31. A shipment of 12,000 tons of coal arrived at Boston on three barges and 2 schooners. Each schooner held $3\frac{1}{2}$ times as much as each barge. Find the capacity of a barge; of a schooner.

32. Leo has 3 times as many plums as Carl. If each had 5 more, Leo would have only twice as many as Carl. How many plums has each?

33. Three pails and 6 baskets contain 576 eggs. All the pails have $\frac{1}{3}$ as many eggs as all the baskets. How many eggs are there in each pail? in each basket?

34. Four wagons drew 38 logs from the woods, one wagon holding 2 logs more than each of the others. How many logs did each wagon hold?

35. A gentleman bought several gallons of wine for $94; and after using 7 gallond himself, sold $\frac{1}{4}$ of the remainder for $20. How many gallons had he at first?

36. A sporting goods merchant purchased an assortment of tennis rackets for $480. By selling $\frac{1}{4}$ of them at $6 each, $\frac{1}{6}$ of them at $7 each, $\frac{1}{3}$ of them at $5 each, and the rest, or $\frac{1}{4}$ of them, at $8 each, he gained $128. How many did he sell at each price?

37. During the year of 365 days one locality had 6 days less of clear weather than of cloudy weather and 4 days more of clear weather than of partly cloudy weather. Find the number of days of each kind.

38. James and William have between them 44 apples, and James says to William, if you will give me 12 of your apples, your number will then be only $\frac{2}{9}$ of mine. William replied, if you will give me 12 of yours, your number will then be only $\frac{3}{8}$ of mine. How many did each have?

39. In my school $\frac{2}{5}$ of my pupils study grammer, $\frac{2}{3}$ of the remainder read, 10 spell, and the remainder, which is $\frac{1}{7}$ of the number that read, study navigation. Required the number of pupils in the school.

40. A merchant bought a number of barrels of flour, and having sold half the number and 4 barrels more to A , and $\frac{3}{4}$ of the remainder wanting 4 barrels to B, he had 20 barrels left. How many had he at first?

41. A general having lost a battle, found that he had only half of his army and 3600 man left fit for action; $\frac{1}{8}$ of the army and 600 men being wounded; and the rest, who were $\frac{1}{5}$ of the whole, either slain, taken prisoners, or missing. How many men were in the army?

42. A company of men attempt to form in a solid square and 56 men are left over. They then attempt to form in a square with three more on a side and 25 more men are needed to complete the square. How many men are in the company?

43. A grocer bought a box of soap containing 72 cakes for $4.50. Some of the soap he sold at 3 cakes for 25¢, and the rest at 10¢ a cake. This gave a profit of $1.90. How many cakes did he sell at each price?

44. An acre of wheat yielded 2000 pounds of straw more than of grain. The weight of the grain was .3 of the total weight of grain and straw. How many 60-pound bushels of wheat were produced?

45. A farmer had two flocks of sheep, each containing the same number. Having sold from one of these 39, and from the other 93, he finds twice as many remaining in the one as in the other. How many in each flock?

46. In a baseball game $\frac{1}{2}$ the number of runs scored by the winning team exceeds 5 by as much as $\frac{1}{3}$ the losing team's runs exceeds 1. If the total runs scored is 18, what is the final score?

47. John and his father went fishing together and caught 12 fish. 3 timesthe number of fish that John caught exceeds 12 by as much as 5 times the number that his father caught exceeds 8. How many did each get?

48. The crew of a United States battleship in target practice made 11 hits in less than a minute. If $\frac{3}{4}$ of the number of shots fired was 9 times the number of misses, how many shots were fired?

49. In lighting a hall a certain number of 20-candle-power electric lamps and twice as many 25-candle-power lamps were used. The total illumination amounted to 280 candle power. Find the number of lamps of each kind used.

50. At an election there were 2 candidates and 1280 votes were cast. The successful candidate had a majority of 40. How many Votes were cast for each candidate?

Table IV. Geometry Problems. - one of each type.

1. If the area of a triangle is 96 square feet, and its base is 16 feet, find its height. (refer to table IV page 19)

2. The sum of the degrees in the angles of a triangle is 180. If the first angle is twice the second and the third is $\frac{3}{5}$ of the second, find the size of each angle.

3. How many degrees are there in each angle of a triangle if the first angle contains as many degrees as the second, and the third contains 3 times as many degrees as the first?

4. How many degrees in an angle which is equal to 4 times its complement?

5. How many degrees in an angle which is $\frac{1}{5}$ of its supplement?

6. The sum of the interior angles of a polygon of n sides is given by the expression $(n-2)180^\circ$. If the sum of the interior angles of a certain polygon is 3600°, find the number of sides of the polygon.

7. A lawn is 50 feet long and 24 feet wide. If arranging a flower bed along the front diminishes the area 125 square feet, find the width

8. A playground is 101 feet longer than it is wide. If its width were decreased 25 feet, its length would be twice its width. Find the dimensions of the playground.

9. The length of a steamship is 790 feet,or 2 feet less than 9 times its width. What is its width?

10. The length of a tunnel was 22½ times its width. If the length had been 50 feet less, it would have been 20 times as the width. Find its length; its width.

11. A bar of metal is to be converted into a plate 6 feet long and 4 feet wide. If the bar is 4 feet long and 3 feet wide, and 1 inch thick, how thick will the plate be?

12. The distance around the top of a desk is 170 inches. If the top is 15 inches longer than it is wide, how wide is it?

13. The length of a room is 8 feet more than its width. If each dimension is increased by 2 feet, the area of the room will be increased by 60 square feet. What is the area of the room?

14. A rectangle is 9 feet longer than it is wide. A square whose side is 3 feet longer than the width of the rectangle is equal in area to the rectangle. What are the dimensions of the rectangle?

15. A field is twice as long as it is wide. By increasing its length 20 rods and its width 30 rods, the area will be increased 2200 square rods. What are the dimensions?

16. The inside walls and ceiling of a room 18 feet by 14 feet by 9 feet, are to be painted. What will be the cost, at 8.5¢ a square yard, if 275 square feet are allowed for doors and windows?

17. A tree 120 feet high was broken so that the length of the part broken off was 4 times the length of the part left standing. Find the

length of each part.

18. A well was deepened to 4 feet more than twice its original depth. If it was finally 22 feet deeper than it was at first, what was the depth after it was deepened?

19. A post is $\frac{1}{5}$ in the earth, $\frac{3}{7}$ in the water, and 13 feet above the water. What is the length of the post?

20. A person bought 2 casks of porter, one of which held 3 times as much as the other; from each of these he drew 4 gallons, and then found that there were 4 times as many gallons remaining in the larger, as in the other. How many gallons were there in each?

21. Out of a cask which had leaked away $\frac{1}{3}$, 13 gallons were drawn, and then being gauged it was found to be $\frac{1}{2}$ full. What was its capacity?

22. 4 places are situated in the order of the letters A,B,C,D. The distance from A to D is 34 miles. The distance from A to B is to the distance from C to D as 2 to 3. And $\frac{1}{4}$ of the distance from A to B, added to half the distance from C to D, is 3 times the distance from B to C. What are the respective distances?

Table V. Investment Problems.- one of each type.

1. A gentleman lent a certain sum of money for 3 years at 5 % compound interest; that is at the end of each year he added $\frac{1}{20}$ to the sum due. At the close of the third year he lost $15,25, but then there remained due to him $2300. Required the sum lent.*

2. From three investments, a man receives $224 interest. The amount invested at 6 % is $400 more, and the amount invested at 5 % is $1000 more than the amount invested at 7 %. How much is invested at each rate?

3. A man invests $\overset{4}{\frac{4}{5}}$ of his capital at $4\frac{1}{4}$ % and the rest at 4 %. His

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*(refer to table V page 20)

annual income is $176. Find his capital.

4. A bank invests $s, part at 6 % and the remainder at 5 %. If the annual income is m dollars, how much is invested at each rate?

5. A man invested $3600, part at 4 % and part at 5 %. If the annual income was the same, what was the amount of each investment?

6. A man has $\frac{2}{3}$ of his property invested at 4 %, $\frac{1}{4}$ at 5%, and the rest at 2 %. What is the value of his property if income is $1225?

7. A man had $15,000 invested, part at 6% and the rest at 3%. If his annual return was 5% of the total, how much was invested at each rate?

8. Lent $780, at 6%, for 5 years. What principal will amount to the sum in 4 years, at 10%?

9. Lent my neighbor Jenkins $270 for 4 years, at 6%; sometime afterwards, I borrowed of him $500, at 8%. How long shall I keep it, to balance the favor?

10. A house cost a dollars and rented for n dollars a month. What per cent per annum was the income from the investment?

11. A man loaned some money at 4% interest, but received $48 less interest on it annually than Mr. Day, who had loaned $\frac{4}{5}$ as much at 6%. How much did each man loan?

12. 2 men made a profit of $15,600 in one year. As one had supplied more capital he received 25% more than the other. Find profit of each.

13. A firm set aside 12½% of the profit made in a year for an income tax. After deducting the amount of the tax, 10% of the balance was distributed as a bonus among the employees. If the sum distributed in this manner was $5600, find the total profit made.

14. The profit in a business in one year was $3500. What was the profit the second year if the average for the two years was $3750?

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15. A and B began trade with equal sums of money. The first year, A gained 40 pounds, and B lost 40. The second year, A lost $\frac{1}{3}$ of what he had at the end of the first, and B gained 40 pounds less than twice the sum which A had lost. B had then twice as much money as A. What sum did each begin with?

16. A man has \$3000 invested at 8% and \$4000 at 7%. How much must he invest at 5% to make his total income be 6% of his investment?

Table VI. Mixture Problems.- one of each type.

1. How much each of 35¢ coffee and 50¢ coffee must a grocer mix to make 100 pounds to sell at 40¢ per pound? (refer to table VI page 21)

2. How many pounds of 25¢ coffee must be mixed with 40 lb. of 60¢ coffee to make a mixture which can be sold for 40¢?

3. In the composition of a quantity of gunpowder; the nitre was 10 lbs. more than $\frac{2}{3}$ of the whole, the sulphur $4\frac{1}{2}$ lbs. less than $\frac{1}{6}$ of the whole, and the charcoal 2 lbs. less than $\frac{1}{7}$ of the nitre. What was the amount of the gunpowder?

4. How much alcohol must be added to 4 gallons of a 30% mixture of alcohol and water to make a 50% mixture?

5. How much water must be added to 60 lbs. of milk containing 5% butter fat to form a mixture containing 3% butter fat?

6. One bar of silver alloy is 40% silver, another bar is 25% silver. How many ounces of each must be taken to make 80 oz. of a new alloy, which will contain 35% silver(when melted together)?

7. In an alloy of 75 pounds of tin and copper there are 12 lbs. of tin. How much copper must be added so that the new alloy may be $12\frac{1}{2}$% tin?

8. In p lbs. of bronze, the amount of tin was m times that of zinc

and n lbs. less than $\frac{1}{r}$ that of the copper. How many lbs. of zinc?

9. How much pure gold must be added to w oz. of gold 18 carats fine so that the alloy may be 22 carats fine?

10. A cask which held 146 gallons was filled with a mixture of brandy wine and water. There were 15 gallons of wine more than of brandy, and as much water as the brandy and wine together. How much of each?

11. A mixture of Canadian and Kentucky bluegrass seed is worth 7¢ a lb. and contains 3 lbs. more of the former than of the latter. If the former is worth 5¢ a lb. and the latter 15¢ a lb., how many lbs. of each?

12. Chemically pure sulphuric acid contains 95% of sulphuric acid. How many pints of it and of distilled water must be taken to make a one gallon mixture which shall be 60% pure?

Table VII. Money Problems. - one of each type.

1. A spendrift spent $\frac{1}{5}$ of the fortune left him by his father, and he then earned \$124. Soon after he lost in speculation $\frac{2}{3}$ of his property, after which he gained \$273. His property was now valued at $\frac{1}{2}$, wanting \$86, of his original estate. What was the sum left him? *

2. John Smith's oldest daughter is 15 years old, and his youngest is 11; he has \$1728, which he wishes to give them. How shall he divide this sum, that each may deposit her share in a bank which pays 6% interest, so that both shall have an equal sum when theybare 21 years old?

3. A asked B how much money he had. He replied, if I had 5 times as much as I now have I could lend you \$60, and then $\frac{1}{5}$ of the remainder would be equal to $\frac{1}{2}$ the dollars I now have. How much did B have?

4. Tom has a certain amount of money in the bank, and Ned has \$4 less than 6 times that amount. Together they have \$80 in the bank. How much has each?

*(for the source of these problems refer to table VII page 22)

5. A had \$27 and B had \$21. A paid B a certain sum and then B had twice as much as A had left. How many dollars did A pay B?

6. A and B have \$24.70 and A has \$6 more than B. How much has each?

7. James said to John, I have 40 shillings more than you. Yes, replied the other, and $\frac{1}{9}$ of yours is equal to $\frac{1}{4}$ of mine. Required the number of shillings that each had.

8. A has 6 times as much as M, how much has each, if the sum is \$3?

9. A sum of money was divided among A,B,and C in such a way that A received 4 times as much as B, and B twice as much as C. If A received \$35 more than C, how great a sum of money was divided?

10.A and B have \$20; A and C, \$22; Band C \$26. How much has each?

11. A gentleman gave in charity \$46; a part thereof in equal portions to 5 poor men, and the rest in equal portions to 7 poor women. Now, a man and a woman had between them \$8. What was given to the men, and what to the women?

12. A and B have the same income. A contracts an annual debt amounting to $\frac{1}{7}$ of it; B lives upon $\frac{4}{5}$ of it ; at the end of 10 years, B lends to A enough to pay off his debts, and has \$160 to spare. What is the income of each?

13. A person after spending \$100 more than $\frac{1}{5}$ of his income, had remaining 35 dollars more than $\frac{1}{2}$ of it. Required his income.

14. A newspaper reporter saved $\frac{1}{5}$ of his weekly salary. This was \$1 more than was saved by an artist on the same paper whose weekly salary was \$5 greater but who saved only $\frac{1}{7}$ of it. How much did get/week?

15.A man's income tax amounts to \$18. He is entitled to an exemption of \$2500 for his family and of \$250 for charities. If the rate of taxation is 1% on the balance, what is his income?

16. A man having spent $\frac{2}{5}$ of his money, finds that he has $\frac{1}{3}$ of his money plus $16 left. How much money had he?

17. What sum of money is that ,whose third part, fourth part, and fifth part, added together, amount to $94?

18. A man having lost $\frac{1}{4}$ of his money, found he had $96 left. Required the sum he had at first.

19. A man found a sum of money, which was equal to $\frac{1}{2}$ of what he had; but having spent $40, the remainder was $\frac{4}{5}$ of the sum he found. Required the sum he at first possessed.

20. Lent Jenkins a sum of money at 6%, which he kept until the interest was $\frac{3}{7}$ of the principal. What was the sum lent if he owed me $500?

Table VIII. Number Problems. - one of each type.

1. What number is that, to which 10 being added, $\frac{3}{5}$ of the sum is 66?*

2. What number is that, to which, if its half **be added**, and from the sum 20 be subtracted, the remainder will be $\frac{1}{4}$ of the number itself?

3. Divide 48 into such parts, that if the less be divided by 4, and the greater by 6, the sum of the quotients will be 9.

4. If to a certain number, 720 be added, and the sum be divided by 125, the quotient will be equal to 7392 divided by 462. Find number.

5. 3 times a number is equal to the number increased by 24. Find the number.

6. If a number is multiplied by 12, the product is 168. Find number.

7. Find a number such that when 9 is added to 3 times it the sum is 42.

8. If a certain number is diminished by 9 and the remainder multiplied by 9, the result is the same as if the number were diminished by 6 and the remainder multiplied by 6. Find the number.

9. If 5 times a certain number is diminished by 3 and the remainder

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*(for the source of these problems refer to table VIII page 23)

multiplied by 23, the result is the same as if 7 times the number were increased by 9 and the sum multiplied by 7. Find the number.

10.Three times the excess of a certain number over 8 is equal to twice the number plus 1. Find the number.

11. 9 times a certain number exceeds 56 by as much as 5 times the number is less than 56. Find the number.

12. The value of a fraction is $\frac{2}{3}$ and its numerator is 3 greater than half of its denominator. Find the fraction.

13. Find a fraction whose value is $\frac{4}{7}$ and whose denominator is 15 greater than its numerator.

14. The numerator of a fraction is 8 less than the denominator. If each term of the fraction is decreased by 5, the resulting fraction equals $\frac{1}{3}$. What is the fraction?

15. What number is that, which is to 12 increased by 2 times the number, as 2 to 10?

16. If a certain number is divided by 12, the quotient, dividend, and divisor, together will be 64. What is the number?

17. Find the number that must be added to the numerator of the fraction $\frac{5}{8}$ to equal the fraction $\frac{1}{8}$.

18. What number added to both the numerator and denominator of $\frac{5}{11}$ will produce $\frac{4}{7}$?

19. What number is that the treble of which, increased by 12, shall as much exceed 54 as that treble is less than 144?

20.$\frac{1}{2}$ of a number exceeds 7 by as much as 50 exceeds the number. Find the number.

21. The sum of $\frac{1}{5}$ and $\frac{1}{6}$ of a number multiplied by 4 equals 88. Find the number.

22. What number is that, to which if $\frac{4}{7}$ of it be added, the sum will be 99?

23. The sum of $\frac{2}{3}$ of a number and $\frac{5}{9}$ of it is 44. Find the number.

24. What number is it whose fourth part exceeds its fifth part by 3?

25. What 2 numbers are those, whose difference is 12, and their squares equal to each other?

26. What 2 numbers are those whose difference is 3, and the difference of whose squares is 51?

27. What 2 numbers are as 2 to 3; to each of which, if 4 be added, the sums will be as 5 to 7?

28. Divide 75 into 2 such parts that one part shall exceed twice the other by 9.

29. The sum of 2 numbers is 60. If the smaller is increased by $\frac{1}{5}$ of the larger, the result is 12 less than the larger. Find numbers.

30. The difference between 2 numbers is 4 and $\frac{1}{4}$ of their sum is 9. Find the numbers.

31. The sum of 2 numbers is 30. If twice the larger number is diminished by 7, the result is the same as when 4 times the smaller number is increased by 5. Find the numbers.

32. The difference between 2 numbers is 6. If 12 is added to the larger, the result is 3 times the smaller. Find the numbers.

33. The difference of 2 numbers is 4, and 7 times the larger is e equal to 11 times the less. Required those numbers.

34. There are 2 numbers whose sum is 24, and if 7 be added to the larger, and 4 to the less, their ratio will be as 4 to 3. Required those numbers.

35. Divide 44 into 2 such parts that $\frac{3}{4}$ of one shall be 6 more than

$\frac{3}{5}$ of the other.

36. Divide 43 into 2 parts so that one of them shall be 3 times as much above 20 as the other wants of 17.

37. The sum of 2 numbers is 35 and 3 times the larger is equal to 4 times the smaller. Find the numbers.

38. Divide 85 into 2 parts so that one shall be 4 times the other.

39. Find 2 numbers whose sum is 14 and whose difference is 8.

40. Separate 120 into 2 parts so that $\frac{3}{4}$ of the smaller part is equal to $\frac{3}{8}$ of the larger part.

41. Divide 25 into 2 parts so that the larger part shall exceed 15 by as much as the smaller part exceeds 6.

42. Divide 37 into 2 parts so that the sum of twice the greater part and 3 times the smaller shall be 87.

43. Divide 39 into 2 parts so that the greater part exceeds twice the smaller by 1 less than twice the smaller part.

44. Divide 160 into 2 parts so that $\frac{3}{4}$ of the larger part exceeds the smaller part by 15.

45. The difference between 2 numbers is 8. If twice the larger is taken from 50, the result is the same as when the smaller is taken from 47. Find the numbers.

46. Divide 11 into 2 parts so that their quotient is 2 and their remainder 1.

47. Separate 54 into 2 parts such that $\frac{1}{12}$ of the difference between them is $\frac{1}{3}$.

48. Divide 36 into 3 such parts, that $\frac{1}{2}$ of the first, $\frac{1}{3}$ of the second, and $\frac{1}{4}$ of the third, shall be equal to each other.

49. What number is that, of which if $\frac{1}{3}$, $\frac{1}{4}$ and $\frac{2}{7}$ be added together

the sum will be 73?

50. The sum of 2 numbers is 60. greater is 4 times the less.

51. The tens' digit os a 2 difit number is 3 times the units' digit. If the number diminished by 33 is divided by the difference of the digits, the quotient is 10. Find the number.

52. The units' digit of a 2 digit number exceeds the tens' digit by 5. If the number increased by 63 is divided by the sum of its digits, the quotient is 10. Find the number.

53. The tens' digit of a 2 digit number is ½ the units' digit. If the number increased by 27 is divided by the sum of its digits, the quotient is 6¼. Find the number.

54. The sum of 2 consecutive numbers is 53. Find the numbers.

55. Find 3 consecutive numbers whose sum is 7 more than the largest.

56. Find 3 consecutive numbers whose sum shall be 5 less than 4 times the least.

57. Find 3 consecutive numbers whose sum is 39.

58. Find 3 consecutive even numbers whose sum is 54.

59. Find 3 consecutive even numbers whose sum is 10 more than the sum of the first 2 consecutive numbers.

60. Find 5 consecutive numbers whose sum is 70.

61. Find 3 consecutive odd numbers such that twice the square of the largest exceeds the sum of the squares of the other 2 by 208.

Table IX. Percentage Problems.- one of each type.

1. Of the population of Mexico at one time the per cent of whites was ½ that of Indians. Mixed races formed 5% more than the per cent of Indians. Find the per cent of each.(refer to table IX page 24)

2. A baseball team won half of the first 80 games it played. How

many of the remaining 60 games must it win to have a rating of .600?

3. A book sells for $1.32. Find the cost of the book if the sales price represents a profit of 10% of the cost.

4. Find the enrollment of a school of 1400 pupils for each of the next 2 years if an increase of 30% of the present enrollment is anticipated for each of the next 2 years.

5. John raised 420 chicks. He estimated that this was 60% of the eggs placed in the incubator. How many eggs were in the incubator?

6. What is the rate of interest on a note for $250 if after 3½ years at simple interest it amounts to $276.25?

7. A merchant purchased an article for $120. At what price must he mark it so that he may sell it at a 25% discount on the marked price and yet make a profit of 20% on the sales price?

Table X.Uniform Motion Problems.- one of each type.

1. An express, travelling at the rate of 60 miles a day, had been despatched 5 days, when a second was sent after him, travelling 75 miles a day. In what time will the one overtake the other?*

2. At what time between 3 and 5, are the hands of the clock together?

3. One boy rides a bicycle at a rate 2 miles an hour faster than a second boy. They travel in opposite directions and are 64 miles apart in 4 hours. What are their rates?

4. An express train, which travels 45 miles an hour, starts 2 hours after an accommodation trains, which it overtakes in 4 hours. What is the rate of the accommodation train?

5. A yacht sailed a certain distance up a river and back in r hours. Its rate per hour was s miles going up and t miles returning. How

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*(for the source of these problems refer to table X page 25)

far up the river did it sail?

6. A certain clock has an hour hand, a minute hand, and a second hand, all turning on the same centre. At 12 o'clock all the hands are together, and point at 12. How long will it be before the second hand will be between the other two hands, and at equal distances from each? Also, before the minute hand will be equally distant between the other two hands? Also, before the hour hand will be equally distant between the other two hands?

7. Two travellers, A and B, 360 miles apart, travel towards each other till they meet. A's progress is 10 miles an hour, and B's 8. How far does each travel before they meet?

8. A workman wishing to explode a blast of powder set the fuse to cause the explosion to take place in 30 seconds. He ran back at the of 8 yards per second. How far had he run when he heard the explotion, if sound travels at the rate of 1080 feet per second?

9. In a recent balloon race, the sum of the distances covered by the Lotus II and the United States was 1025 miles. The distance covered by the former was 50 miles more than $\frac{1}{2}$ the distance covered by the latter. How far did each travel?

10. Two men start from the same place and travel in opposite directions, one at the rate of 35 miles a day and the other 25 miles a day. In how many days will they be 360 miles apart?

11. A man walked 10 miles. He returned in a car at the rate of 30 miles an hour. If he was gone 4 hours, what was his rate walking?

12. A fox is pursued by a greyhound, and is 60 of her own leaps before him. The fox makes 9 leaps while the hound makes but 6; but the latter in 3 leaps goes as far as the former in 7. How many leaps does

the greyhound make before he catches the fox?

13. A ship sails 4 degrees north, then 13 S. then 17 N. then 19S. and has finally 11 degrees of south latitude. What was her latitude first?

14. A ship and a boat are descending a river at the same time. The ship passes a certain fort, whan the boat is 13 miles below. The ship descends 5 miles, while the boat descends 3. At what distance below the fort will they be together?

15. Some men can row 12 miles downstream in the same time that it takes them to row 4 miles upstream. What is their rate of rowing in still water if the rate of the current is 2 miles an hour?

16. A steamboat that goes 12 miles an hour in still water takes as long to go 16 miles upstream as to go 32 miles downstream. Find the velocity of the stream.

17. A passenger train travels $1\frac{1}{3}$ times as fast as a freight train. It leaves a station 2 hours after the freight and overtakes it after going 240 miles. Find the rate of each train.

18. What is the rate in feet a second at which a bullet travels if a marksman hears his bullet strike a target 1100 feet away, 3 seconds after the discharge? (Sound travels 1100 feet a second).

19. A, travelling 20 miles an hour was overtaken $1\frac{1}{2}$ hours after starting, by B, who left the starting point 45 minutes after A. Find the rate at which B was travelling.

20. A freight train runs 6 miles an hour less than a passenger train. It runs 80 miles in the same time that the passenger train is running 112 miles. Find the rate of each.

21. An express train on the Union Pacific Railroad whose rate is 40 miles an hour starts 1 hour 4 minutes after a freight train and over-

takes it in one hour 36 minutes. What is the rate of the freight?

22. A passenger train travels 10 miles an hour faster than a freight. If it leaves a station 2 hours after the freight, and overtakes it in 8 hours, find the rate of each train.

23. A Western train travelled a certain distance in 5 minutes. If its rate per minute had been $\frac{1}{5}$ of a mile more, it would have covered the distance in $4\frac{1}{2}$ minutes. Find its rate per minute.

24. A manfinds that it takes his naphtha launch 2 hours to go 24 miles with the tide, and 4 hours to go 8 miles against the tide. Find the rate of the tide in miles per hour.

Table XI. Value Problems. - one of each type.

1. My horse and chaise are worth $336, but the chaise is worth 5 times as much as the horse. What is the value of each?*

2. A man being asked the value of his horse and saddle, replied that his horse was worth $114 more than his saddle, and that $\frac{2}{3}$ the value of the horse was 7 times the value of his saddle. What was each's value?

3. A's and B's estates are valued at $3240, but B's is only $\frac{7}{8}$ the value of A's. What is the property of each?

4. I have 2 carriages; the value of one is 5 times that of the other, and the value of my horse is equal to both of my carriages. The worth of them all is $300. What is the value of each ?

5. A gentleman bought a chaise, horse and harness for $360. The horse cost twice as much as the harness; and the chaise cost twice as much as the other two together. What was the price of each?

6. Mr. Evans has $\frac{2}{5}$ of his property invested at 4%, $\frac{1}{3}$ at 5%, and the remainder at 3%. For how much is his property valued? Income is $610.

7. A certain man added to his estate $\frac{1}{4}$ its value, and then lost $760.

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*(for the source of these problems refer to table XI. page 26)

But he afterwards gained $600. His property then amounted to $2000. What was the value of his estate at first?

8. A man has 2 farms, and his stock is worth $183. Now, the stock and his first farm is worth once and two-sevenths the value of the second farm, but the stock and the second farm is worth once and five-eighths the value of the first farm. What is the value of each farm?

9. I have 2 horses, and a saddle worth $30. Now, the saddle and the first horse are worth $\frac{3}{5}$ the second horse, but the saddle and the second horse are worth 3 times the first horse. Find the value of each.

10. A merchant gains or loses, in a bargain, a certain sum. In a second bargain, he gains $350, and in a third, he loses 60. In the end he finds he has gained $200, by the three together. How much did he gain or lose by the first?

Table XII. Work Problems.- one of each type.

1. A man was hired for 50 days. Each day he worked he was to receive $2 and each day he was idle he was to pay 50¢. At the end of the 50 days he received $80. How many days did he work? *

2. One boy can do a piece of work in 12 days. After working 4 days, he is joined by a second boy and they finish the work in $3\frac{1}{5}$ days. How long would it take the second boy to do the work alone?

3. Arthur and Louis can dig a ditch in 10 days, Louis and John can dig it in 6 days, and Arthur and John in $7\frac{1}{2}$ days. In what time can each do the work?

4. One boy can mow a certain lawn in 4 hours. If a second boy helps him, they can do the work together in $1\frac{5}{7}$ hours. How long will it take the second boy to do the work alone?

5. A can do a piece of work in 4 days, B in $3\frac{1}{2}$ days, and C in 5 days.

*(for the source of these problems refer to table XII page 27)

et he afterwards gained $[illegible]. In property that amounted to $2000. What was the value of his estate at first?

5. A man has 2 farms, and his stock is worth $150. Now, the stock and his first farm is worth once and two-sevenths the value of the second farm, but the stock and the second farm is worth once and five-eighths the value of the first farm. What is the value of each farm?

9. I have 2 horses, and a saddle worth $50. Now, the saddle and the first horse are worth [illegible] the second horse, but the saddle and the second horse are worth 2 times the first horse. Find the value of each.

10. A merchant gains or loses, in a bargain, a certain sum. In a second bargain, he gains $350, and in a third, he loses $60. In the end he finds he has gained $250, by the three together. How much did he gain or lose by the first?

Table XII. Work Problems.- One of each type.

1. A man was hired for 30 days. Each day he worked he was to receive $2 and each day he was idle he was to pay $1. At the end of the 30 days he received $20. How many days did he work?

2. One boy can do a piece of work in 12 days. After working 4 days, he is joined by a second boy and they finish the work in $4\frac{1}{2}$ days. How long would it take the second boy to do the work alone?

3. Arthur and Bruce can dig a ditch in 10 days, Bruce and John can dig it in 8 days, and Arthur and John in $7\frac{1}{2}$ days. In what time can each do the work?

4. One boy can mow a certain lawn in 4 hours. If a second boy helps him, they can do the work together in $1\frac{1}{2}$ hours. How long will it take the second boy to do the work alone?

5. A can do a piece of work in [illegible] days, B in $6\frac{1}{2}$ days, and C in [illegible] days.

How long will it take them to do the work if they work together?

6. One man can do a job in 10 days, and a second man in 8 days. How long will it take them to do the job if they work together?

7. A tank can be filled by one pipe in a hours and by a second pipe in b hours; it can be emptied by a third pipe in c hours. If all 3 pipes are open, how long will it take to fill the tank?

8. A san hoe 4 rows in an hour; B, 3 rows; and C, 2 rows. How many hours will it take the three together to hoe 126 rows?

Table XIII. Miscellaneous.- one of each type.

1. The powder and the shell used in a 12-inch gun weigh 1265 pounds. The powder weighs 15 lbs. more than $\frac{1}{4}$ as much as the shell. Find the weight of each. (for the source of these problems refer to T.XIII)

2. 1 ton of coal will make 8.7 tons of steam. If an ocean liner requires 1200 tons of coal a day for steam, how many tons of steam are required an hour?

3. A merchant supported himself 3 years, for £50 a year, and at the end of each year added to that part of his stock which was not thus expended, a sum equal to 1/3 of this part. At the end of the third year his original stock was doubled. What was that stock?

4. At the waterworks 2 large pumps and 4 small ones delivered 4800 gallons/minute. Each of the large pumps delivered 4 times as much water as each small pump. How many gallons/minute did each pump deliver?

5. 2 pieces of cloth, at the same price by the yard, but of different lengths, were bought, the one for £5, and the other for £$6\frac{1}{2}$. If 10 be added to the lengths of each, the sums will be as 5 to 6. Find lengths.

6. A bottle of water weighs 24 oz. When it is filled with a liquid $1\frac{1}{3}$ times as heavy as water, it weighs 30 oz. Find weight of bottle.

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